Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME CI

MARCH, 1918, to AUGUST, 1918

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

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY

INDEX.

NAME INDEX.

TITLE INDEX.

ASTRONOMICAL NOTES.

CORRESPONDENCE.

DEATHS

REVIEWS AND OUR BOOKSHELF.

Agriculture and Horticulture:

Anthropology and Archæology:

Biology:

Chemistry:

Engineering:

Geography and Travel:

Geology and Mineralogy:

Mathematical and Physical Science:

Medical Science:

Metallurgy:

Miscellaneous:

PRINTED IN GREAT BRITAIN BY RICHARD CLAY AND SONS, LTD., BRUNSWICK STREET, STAMFORD STREET, S.E. 1, AND BUNGAY, SUFFOLK

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

THURSDAY, MARCH 7, 1918.

CAMBRIDGE STANDARDS OF VALUE.

Cambridge Essays on Education. Edited by Dr. A. C. Benson. With an Introduction by the Rt. Hon. Viscount Bryce. Pp. xix + 232. (Cambridge: At the University Press, 1917.) Price 7*s.* 6*d.* net.

THESE essays, with one notable exception, constitute an appreciation and a defence of a classical education. They set forth all that is best in classical and literary studies, and abound in stimulating thoughts and provocative theories. But, with one exception, the writers have no great belief in scientific studies; though Cambridge essays, they do not represent Cambridge thought, of which Mr. Bateson assures us the dominant forces come from the scientific school. Even the Dean of St. Paul's, who has natural leanings towards science, pronounces scientific studies to be thin—like the air on the mountain-tops—whilst he admits that they are pure and bracing. But with all this fear of science there is in most of the essays the feeling of an unfulfilled hope, which is not allayed by the somewhat forced and artificial methods with which the writers seek to stimulate interest in literary studies. They have great possessions, but something is lacking; that something, students of science may claim, is the outlook of science.

It will be admitted that the advent of such mighty things as modern scientific discoveries might be expected to awaken a new curiosity and bring with it a new revelation. But unfortunately the outlook and aims of science are little understood and are confused with other motives. Mr. Paton, for example, declares science to be the embodiment of materialism. The last century, with all its brilliant achievement in scientific discovery, was, he tells us, spiritually a failure. He is probably mixing up science with what he sees around him in business. Sir John McClure, who writes on vocational training and is so distrustful of it, does the same. He quotes with approval from the speech which Mr. Hichens addressed to the Headmasters' Association. But Mr. Hichens is not thinking of science; he is thinking of "business." For high business capacity he does not want a man trained in science; he wants him trained in classics, to be a man of ability and of moral strength of character. This is one type. For research he will employ a man trained in science.

The difference arises from the existence of these two types of men; and these types, Mr. Bateson candidly tells us, scarcely know each other—their outlook and methods are diverse, and this diversity affects thought, ways of looking at things, and mental interests. One type is possessive, as Mr. Russell might say, the other creative. Mr. Hichens is, naturally enough, thinking of the conventional qualifications of the governing type; but in the changing order of affairs it is not so certain that this type will be able to deal with the new relationships which are in rapid process of development. At any rate, men of this kind are in full power in the State, in Government offices, and in many business affairs, and they have not prevented strikes, or wars, or revolutions; and at the moment their methods and aims and powers are in a fair way towards paralysis. Who can tell whether the men of research will not be called from their laboratory to save and reconstruct the State?

"The rapture of the forward view," which Dean Inge quotes as belonging to science more than to any other study, is much needed to-day if we are to be saved from disaster. Dr. Inge discusses many important educational problems. He reminds us that the aims of education should be the knowledge, not of facts, but of the relative value of them, and he insists on training the reasoning faculties, and not in placing faith in intuition. He even traces the instinct of acquisitiveness, so prevalent amongst the governing and possessive classes, to the absence of trained reason. No one, he says, who had formed any reasonable estimate of the relative values of life would devote his time to exploiting his neighbours. It is a question, however, whether too much reliance may not be placed on reasoning—for the value of things, which are the premises, may change.

Dr. Inge apparently does not believe in change of values, and is thereby led to distrust democracy and pin his faith to aristocraticism. Democracy in education, he tells us, is a leveller, and its tendency is to level down all superiorities in the name of equality and good fellowship. This may be the appearance of it under its present state of bondage, but it is not the true, effective democracy. Democracy in education means the opening of education to everyone, and it is along these lines that reconstruction of education must follow. At present the education and codes of the public schools are aristocratic. Democracy means the opening of education to every boy or girl, the raising of the weakest, the multiplying of educational opportunities to give scope for individual capacities; it means the introduction of scientific and technical studies, and the extension of the method to literature and to art. Democracy means change of values, and this change is at the root of science education. Mr. Bateson, in a fine passage, reveals the vital influence of science.

> Natural knowledge is destined to give man not only a direct control of the material world, but new interpretations of higher problems. Those who have grasped the meaning of science, especially biological science, are feeling after new rules of conduct.

He continues:—

> The general ignorance of science has lasted so long that we have virtually two codes of right and duty, that founded on natural truth and that emanating from tradition, which almost alone finds public expression in this country. Whether we look at the cruelty which passes for justice in our criminal courts, at the prolongation of suffering which custom demands as a part of medical ethics, at this very question of education, or indeed at any problem of social life, we see ahead and know that science proclaims wiser and gentler creeds.

The two essays of Dr. Inge and Mr. Bateson should be carefully studied.

Dr. Benson writes pleasantly and suggestively on imagination, or, strictly speaking, literary imagination, not the imagination which science provokes; and the Headmaster of Sherborne follows with an essay on the place of literature in education. Both essays are enjoyable reading. We wish, however, that Dr. Benson would add scientific and technical work to his curriculum, with workshops laboratory, agriculture, and his own methods of literary and artistic teaching; then he would have no need for hobbies, and the "way of play" would be transferred to the more delightful "way of work."

Space will only permit of brief reference to the other important questions discussed in these essays. The neglect of science, the alarming absence of the science outlook in the State services, the cramping effects of examinations, are the agitating questions of the day. Uninspired by the science outlook, the Consultative Committee of the Board of Education gives as a reason for reconstruction that men must continue to work in order that our great firms may make money, or wages will go down; and knowing that the Board itself had killed the people's higher grade schools, it makes the remarkable statement that the scholarship method of passing from the elementary to the secondary schools is too firmly rooted in the mind of the country to be dislodged. We believe that these opinions are due to the neglect of science and to the absence of men of the scientific type. But how can we get scientific ideas into the life of the nation? We agree with Mr. Bateson that to replace Greek by chemistry, or to force "science for all" into the public schools, is only playing with the question. What is wanted is that science on a large and comprehensive practical and technical scale should be taught in the schools, so that boys of scientific aptitude and tastes may revel in inspiring fields of research and study. The schools would then turn out a race of men with new ideals inspired by the "onward march." Such men would be able to govern, but in a different way.

WEBB'S "CELESTIAL OBJECTS."

Celestial Objects for Common Telescopes. By the Rev. T. W. Webb. Sixth edition, thoroughly revised by the Rev. T. E. Espin. Vol. i., pp. xx+253; vol. ii., pp. viii+320. (London: Longmans, Green, and Co., 1917.) Price 7*s*. 6*d*. net each.

WHEN the first part of the fifth edition of this book appeared in 1893 we were not alone in finding fault with the way in which, to avoid alteration of Webb's work, most of the correction, revision, and amplification was relegated to an irritating series of footnotes. Old readers probably had an earlier edition if they desired undiluted Webb; new ones could scarcely be attracted by such a cumbersome device. Yet, after an interval of nearly a quarter of a century, an interval as great as that between Webb's own second edition and the Espin-Webb fifth edition, we find the very same fault repeated with all the aggravation due to the increasing number and importance of these footnotes. We must attribute the blame to the editor or the publisher, as we may easily acquit Messrs. Denning and Phillips, who provide so many of these important additions and corrections, of any choice in the form of their presentation. We feel that a great opportunity has been lost. A book of the kind being wanted, the appearance of this "revision" may very well discourage the production of a more consistent work.

The main part of this edition is very similar to the last, with which we dealt some twenty-four years ago. Some of our objections have been met by correction, and others ignored. The second volume, for which Mr. Espin took responsibility in the fifth edition, in which for the first time it was printed separately, has certainly benefited by the adoption of some of the suggestions then made by Mr. Lewis, whose hints are acknowledged in the preface, inasmuch as more recent measures of binary stars are now incorporated; in fact, many were specially observed for this edition.

The second volume, however, is not on the same plane as the first. It is more ambitious, and aims at the inclusion of much that cannot by any stretch of imagination be considered applicable to the "common telescopes" for which the work was originally planned. The index still fails to reach Mr. Lewis's ideal, though that of the southern sky, thanks to Mr. Innes, is much more complete. Even in the first volume there is much to be found quite admirable in its advance upon the earlier edition. The out-of-date charts of Mars and the moon are replaced by the excellent drawings of Antoniadi and Goodacre, but the valuable additional notes on the lunar formations, instead of being incorporated with the body of this section, which is one of the best in the book, are put separately in an appendix.

The increasing size of instruments in the hands of amateurs, which provides the excuse for the expansion of the second volume, naturally accounts for the insertion of a section dealing with the micrometer, and Mr. Franks has given a fairly complete account of it. But we must take exception to a remark of his on the moving wire. It may happen that bad clock driving by confining one hand to the slow-motion rod may compel the observer to treat one of his moving wires as fixed. But surely we need not accept Mr. Franks's opinion that this is the best method in all cases.

There are some obvious misprints (*e.g.* nubulæ for nebulæ, and Melothe for Melotte), but we select as an example of a blemish in the original work uncorrected by footnote or otherwise the extravagant language on p. 233, where we find once more the expressions "inconceivable velocity" and "one of the greatest marvels of the universe" applied to the simple effect of perspective as the comet of 1843 passed from one side of the sun to the other as viewed from the earth.

W. W. B.

OUR BOOKSHELF.

Short Logarithmic and other Tables. By Dr. W. Cawthorne Unwin. Sixth edition. 43 pp. (London: E. and F. N. Spon, Ltd., 1917.) Price 1*s*. 6*d*. net.

THESE tables were compiled by Prof. Unwin to facilitate arithmetical calculations in cases where great accuracy is unnecessary, and are selected and so arranged as to be specially useful in the solution of engineering problems. That the book has been of service to many engineers is evident from the fact that it has reached its sixth edition. The first table gives five-figure logarithms (by use of proportional parts) of numbers up to 9999, and occupies four pages, being followed by antilogarithms. Trigonometrical tables for the natural functions of angles and their logarithms are given for intervals of one minute. Several tables follow, which are adapted for simplifying engineering calculations, such as squares, cubes, square roots, cube roots, hyperbolic logarithms, height of fall to produce a given velocity, and velocity due to falling from a given height. There are also included tables of areas and circumferences of circles, and a segment table, as well as tables of weights of engineering materials. In addition, the book contains a large number of factors for conversion from the British to the metric system, and *vice versa*. The usefulness of a set of mathematical tables depends very greatly upon the facility with which the information required can be obtained, and the arrangement of the present set leaves little to be desired in this respect.

Health in Camp. By Dr. A. T. Nankivell. Pp. ix+84. (The Chadwick Library.) (London: Constable and Co., Ltd., 1917.) Price 1*s*. net.

THIS little book is an amplification of a series of Chadwick Trust Lectures delivered by the author three years ago. It gives in simple language which can be understood by the veriest tyro an outline of camp sanitation and how to ensure health in camp. The author throughout emphasises the use of the simplest materials and those which are to hand. For example, a grease trap at a washing place may be constructed as follows: A large biscuit tin or oil-drum without a top has a few holes pierced at the bottom. The tin is then filled with heather, gorse, bracken, or wood shavings, and the soapy water is poured in at the top. The water passes through into an earth drain, leaving the fat behind. The bracken, heather, etc., are removed twice a day and burnt in the camp incinerator.

The empty food tins and incinerator ashes of the camp may be utilised for path-making, and bully-beef or biscuit tins may be built up one upon another so as to make a firm and well-acting incinerator. Final chapters deal with insect pests and the minor ailments of camp life, including the important item of the care of the feet. We feel sure that this book will be useful and interesting to all those who live a life in camp, whether they be soldiers, boy scouts, or the less pretentious dwellers in caravans.

Rustic Sounds and other Studies in Literature and Natural History. By Sir Francis Darwin. Pp. 231. (London: John Murray, 1917.) Price 6*s*. net.

A VERY real, if somewhat elusive, charm attaches to most well-finished works the creation of which is felt instinctively to have been a labour of love. "Rustic Sounds and other Studies" possesses this quality in a marked degree, and the essays themselves suggest the pleasant conversation of a friend who is drawing on the resources of ripened experience, which he desires to share with others. A certain note of personal intimacy seems to run through the whole volume, and even such debatable matters as the proper aims, means, and objects of education are discussed in such a way that even those who may differ from the author will scarcely seek to quarrel with him.

It is, however, when touching on those branches of plant physiology which he has himself so successfully cultivated that Sir Francis Darwin appears perhaps at his best. The ease with which he makes recondite matters plain and the living atmosphere with which he surrounds his subject can scarcely fail to excite a response in everyone who is not utterly dead to intellectual stimulus.

The volume is essentially one to possess, for every page can be read with interest, whilst its graceful style will surely commend it to a wide circle of friends.

J. B. 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.]*

The Stimulation of Plant-growth by Electric Fields.

THE experiments on the electric stimulation of vegetable growth, initiated in this country by Sir Oliver Lodge and others, are generally held to have given a substantial result. But there does not seem to be any definite view among botanists and experimenters as to the way in which it is brought about.

It appears that present practice is to fix a horizontal network of wires ten yards apart at a height of five yards above the ground, and to maintain it at an electric potential of 120,000 volts. This gives a vertical field of about 200 volts per centimetre, which is not far from a hundred times the order of magnitude of the natural atmospheric gradient. The procedure suggests that it is the field of force that is expected to produce the stimulation. The comparatively trifling amount of electricity that leaks from the wires into the atmosphere could scarcely produce directly any sensible effect.

It has, of course, been surmised for a long time that one function of spicules and edges and hairs on vegetation may be to promote discharge into the atmospheric electric field. Although electrostatic discharge is a surface phenomenon, the growing points may thus be stimulated by the electric field, there very highly concentrated. A positive gradient might conceivably have a different effect from a negative one. The discharge would go on at the enhanced rate due to the increased field, even if the wire grating were protected entirely from leakage. In that case no motive power would be required to maintain its potential, notwithstanding the current that is produced. No paradox is thereby involved. If the atmosphere were absolutely still, the current would pass from the earth to the wires, and leakage would be an essential part of it. But actually the electric discharge from the spicules of the vegetation is mainly borne away on the breeze, and whatever power is needed to sustain the action is contributed from the energy of the wind. It would appear that effective observations might go on even in the limited space of an ordinary greenhouse, using a grating attached to a static source of potential.

J. L.

Cambridge, February 14.

Photographic Determination of the Altitude of the Aurora of December 16, 1917, in Christiania.

IT may be of interest to readers of NATURE to know that I succeeded in obtaining a series of simultaneous photographs of the aurora of December 16 last from two stations—Christiania and Aas, twenty-eight kilometres from each other.

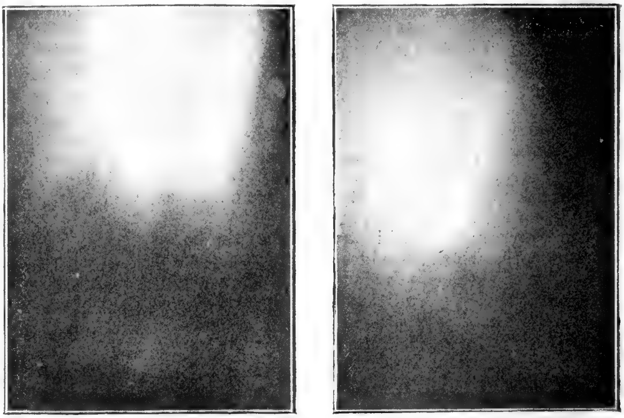


FIG. 1.—Aurora rays, December 16, 1917, 21h. 9m. G.M.T., photographed simultaneously from Christiania (left) and Aas (right). The rays reached down to a height of 100 kilometres above the earth. Stars of the Great Bear constellation are seen in the photograph.

The measures give altitudes of the *same* order as those obtained in Bossekop in 1913—that is, about 100 km. for the lower border of rays and curtains. This agrees with other measurements of the aurora

FIG. 2.—Corona, December 16, 1917, 21h. 10m. G.M.T. in Christiania. Exposure two seconds. Stars of the constellation Auriga are seen to the right.

of February 15, 1917, with the same base, Christiania-Aas.

It seems, then, that the cosmic rays causing the aurora have the same penetrability as those causing the aurora *in the aurora zone*, and that the southern situation is due to systems of corpuscular currents outside the earth, currents which are also the principal cause of the accompanying magnetic storms (see my Memoir in the *Archives des sciences physiques et naturelles*, Geneva, 1911–12).

The photographs were taken with plates only sensitive to blue and violet rays. As red rays occurred

FIG. 3.—Corona, December 16, 1917, 21h. 11m. G.M.T. in Christiania. Stars of the constellation Perseus are seen near the centre, and Capella appears near the left border, though its image is deformed owing to the short focus lens used.

during the aurora, no measurements of these interesting phenomena were obtained. I have written to England for red sensitive plates, and if I succeed in securing them further important results may be obtained.

The illustrations represent a pair of photographic views of aurora rays, and photographs of the corona, showing that the rays are curved a little in their upper parts, which extend to about 400 km. above the earth.

CARL STÖRMER.

University of Christiania, January 28.

Eastern and Western Asymmetry of Solar Prominences.

REGARDING the suggested physical origin of a seeming predominance of solar prominences seen on the east limb as compared with the west limb, referred to in NATURE of January 31, p. 425, allow me to direct attention to numerous observations I have made which leave no doubt as to a predominance of deflection effects on and near the east limb being mostly to the violet, whereas west of the central meridian and on the west limb they are mostly towards the red. This feature is confirmed by the observations of M. Deslandres, and an illustrated account is given by him in the Paris *Comptes rendus*, tome 155, p. 1573 (séance du 30 décembre, 1912).

The deflection effects recently reported in the *Astrophysical Journal* by Mr. F. Ellerman are, in my opinion, the spectroscopic disc representation of the brilliant, and in most cases radially set, sharp "spikes" which an active area invariably exhibits when passing the limbs. I have seen the short-lived brilliant effects on the disc very often and their quick subsidence into dusky and dark forms, the brilliant initial outburst and its dusky sequence being distinctly punctuated by a very brief interval of partial or entire invisibility, owing to the luminosity passing the stage of that of the general disc itself. The life of the "spikes," when seen on the limb, is of the same brevity, and the identity of the two phenomena has long since been recognised by me from these observations and their interpretation.

ALBERT ALFRED BUSS.

22 Egerton Road, Chorlton-cum-Hardy, Manchester, February 26.

A GRAHAM BELL TELEPHONE MEMORIAL.

THE Duke of Devonshire, Governor-General of Canada, on behalf of the Bell Memorial Committee, presented on October 24, 1917, to the town of Brantford, Ontario, a public park which will be known as the Alexander Graham Bell Gardens, the house in which the invention of the telephone was made, and a memorial monument to the inventor himself. For the accompanying photograph of the memorial we are indebted to the courtesy of Mr. G. H. Grosvenor, editor of the *National Geographic Magazine* of Washington. It is by the sculptor, W. S. Allward, and is allegorical. The figure on each side, one representing the speaker and the other the listener, is in bronze, and mounted on a granite pedestal. The panel on the crest of the memorial represents "Humanity in communication," the three shadowy figures being Knowledge, Joy, and Sorrow. They are bound together by lines representing telephone wires, the curved outline of the upper part of the monument representing the curvature of the earth. On the right and left are two circular panels inscribed as follows: "Opus Telephonica Patri Dedicatum Est" and "Mundus Telephonica Usu Recreatus Est." Underneath the central panel are the words: "To commemorate the invention of the telephone by Alexander Graham Bell in Brantford in 1874."

We congratulate the Canadians on having acquired such an interesting memorial of the great inventor. Dr. Bell's invention laid the foundation of a great and flourishing industry, which employs many hundreds of thousands of men and women, and in which many hundreds of millions of pounds are invested. He is one whom every man of science and engineer delights to honour.

It is interesting to remember that Dr. Bell's father, Mr. Alexander Melville Bell, the inventor of a well-known "visible speech" system, was for many years a lecturer on elocution in Edinburgh. His mother was a daughter of Surgeon Symonds, R.N. He himself was born in 1847, and educated at the Royal High School, Edinburgh. When fourteen years old he came to London, and was instructed by his grandfather, Alexander Bell, in elocution and the mechanism of speech. He was a teacher at Weston House Academy, Elgin, for a year, and then entered Edinburgh University, where he studied Latin under Sellar and Greek under Blackie. After being a schoolmaster again at Elgin and also at Somerset College, Bath, he became assistant to his father, who was then lecturer on elocution in University College, London. In 1868–70 Dr. Bell matriculated at London University and attended medical classes at University College. As he was very delicate and as two of his brothers had died from tuberculosis, his father decided to emigrate to Canada in the hope of saving his life, and took a house at Brantford, near Tutela Heights, Ontario. In 1871 Dr. Bell gave instruction to the teachers of deaf-mute children in Boston, and in 1873 he was appointed professor of physiology at Boston University.

Dr. Bell began his career as an inventor very early. When sixteen years of age he invented a method of removing husks from wheat, and in conjunction with one of his brothers made a speaking automaton. In 1874 he invented a system of harmonic multiple telegraphy, and greatly improved his "articulating telephone." Amongst his later inventions we may mention the photophone, the induction balance, the telephone probe, the spectrophone, and, with C. A. Bell, the graphophone. In 1903 he invented tetrahedral kites, and in conjunction with the Aerial Experiment Association (1903–8) suggested numerous improvements in connection with aeroplanes. The outcome of their joint work was the "Red Wing," which made the first public flight in America at Hantsport, Mass., in March, 1908.

This country was in no hurry to honour Dr. Bell. It was not until 1906 that Oxford University made him a Doctor of Science, and not until 1913 that the Royal Society gave him a Hughes medal and the Institution of Electrical Engineers made him an honorary member. Surely never were honours better deserved. He is held in universal esteem by electricians the world over, and although his inventions have brought him fame and wealth, he is one of the most modest of men. As he is only seventy-one years of age, we hope that he will yet be spared for a long time, so that he may see the great expansion of the telephone industry which we anticipate in the immediate future.

A. R.

Memorial erected at Brantford, Ontario, to commemorate the invention of the telephone.

THE RADIO-ACTIVITY OF SOME CANADIAN MINERAL SPRINGS.

DR. J. SATTERLEY, whose work on the radio-activity of the atmosphere, of river and well waters, and of the ocean is well known, and Mr. R. T. Elworthy, of the Canadian Department of Mines, in Bulletin No. 16, part i., issued by that department, report on the radio-activity of forty-seven mineral springs and twenty-three deep-well waters of the Dominion, the chemical character and composition of which are later to be dealt with in part ii. The examination was undertaken in view of the belief that the therapeutic value of mineral waters may be ascribed to their radio-activity, a hypothesis which, on account of the high radio-activity of many of the spas, celebrated from very early times, and the lack of virtue in the same water, transported from the spa, or waters artificially prepared to identical chemical composition, is certainly a plausible one.

The content of the water, both in radium emanation, which, of course, disappears spontaneously on keeping, and in radium itself, which acts as a permanent source of fresh emanation, has been investigated, the Canadian waters being characterised usually by the absence of dissolved radium, although frequently possessing relatively considerable amounts of the emanation. Fifty of the springs and wells examined were situated in eastern Ontario and western Quebec, a map of this district showing their location, but at a later date the well-known hot springs of Banff, at the eastern gate of the Canadian Pacific railway across the Rockies, were also included and found to be the most radio-active of those yet examined in Canada. Very full and clear descriptions and plates of the method of testing and apparatus employed are given, together with plates of twenty-one of the springs. The unit of measurement adopted is the scientific one, either 10^{-12} curie of emanation, or 10^{-12} gram of radium per litre of water, respectively.

The well waters contained from little or nothing up to 176 units of emanation, averaging 60 units for the twenty-three examined, dissolved radium not being detectable. For comparison may be cited the figures 130 and 196 units obtained by Satterley for two of the well waters of Cambridge (England). The springs, excluding those of Banff, contained on the average for forty, 120 units, 345 units being the highest. For these the dissolved radium was usually very small, rarely exceeding 5 or 10 units; but two springs were exceptional, the Philuder spring of St. Hyacinthe, Quebec, with 46 units—the highest recorded—and the Carlsbad "Magic" spring, eight miles from Ottawa, with 25 units. All the seven Banff springs examined were uniformly high in emanation content, from 220 to 640 units, with an average of 400 units, the radium content being 8·5 units, with the exception of the "Auto-road" spring, with 23·5 units, which also had the highest emanation content. Estimates of the flow are given, and in some cases the gases evolved were also examined both for emanation and by chemical analysis.

Compared with the most radio-active springs known, such as those of St. Joachimsthal, near the famous pitchblende deposits, at Plombières (France), Bath (England), and the hot springs of the Yellowstone Park and Arkansas, or of the majority of the spas celebrated for their medicinal powers, none of the Canadian springs are so radio-active. The water of the King's Well, Bath, for example, has an emanation content of 1730, and a radium content of 139. The Quebec and Ontario springs are, however, of the same order in emanation content as the group of springs at Saratoga, N.Y. The Banff springs are regarded as resembling closely the Bath springs both in mineral constituents and in the character of the gases evolved, with an emanation content about one-fourth or one-fifth as great. Banff being probably the chief Canadian health resort of the future, owing to its magnificent surroundings, it is suggested that the hot springs should be utilised in the manner now adopted at Bath. No results were obtained such as might indicate the existence of radio-active minerals in the neighbourhood of the springs, Canada being apparently exceptionally poor in such minerals, and the waters are in no case suited for bottling as radio-active waters, owing to their poverty in dissolved radium.

F. S.

PROF. E. A. LETTS.

PROF. E. A. LETTS, of Queen's University, Belfast, died on February 19 in his sixty-sixth year as the result of a cycling accident in the Isle of Wight.

After a distinguished career at King's College, London, in Vienna and Berlin, Prof. Letts was appointed chief assistant at Edinburgh University in 1872 at the early age of twenty. Four years later he became the first professor of chemistry at University College, Bristol, and in 1879 he was appointed professor of chemistry at Queen's College, Belfast, in succession to the late Thomas Andrews, F.R.S., which position he held until failing health compelled him to resign early last year.

Prof. Letts was a man of singular personal charm, and inspired immense respect and affection in his students, to whom he was not merely the kindly teacher, but also the sympathetic friend who interested himself in all their affairs. He took a large part in establishing the Students' Union in Belfast, and was also prominently identified with the Better Equipment Fund, which aimed at raising 100,000*l.* locally for the provision of laboratories and other essential needs of the college. What this fund has meant to the college only those can appreciate who studied or taught under the conditions prevailing before its inception.

The scientific work of Prof. Letts covered much ground. He possessed great experimental skill, and an out-of-the-way problem, or one involving an unusual amount of manipulative dexterity, attracted his immediate interest. Early in his career he did much work upon the troublesome group of the phosphines. Later, he devoted some attention to the accurate determination of carbon dioxide in water and air, with the result that he was asked to devise the methods to be employed by the first Scott Antarctic Expedition in examining the atmosphere, and to report upon the results obtained.

Prof. Letts was best known, however, as an authority on questions connected with the pollution of rivers, especially of estuaries and tidal waters. During his thirty-seven years' tenure of the chair of chemistry at Belfast he had ample opportunity for the study of the problems associated with the rapid growth of the city and the insanitary conditions that afterwards developed in the upper reaches of Belfast Lough. These investigations, extending over many years, led to the publication of several papers on points of scientific interest, which were inquired into by Prof. Letts and his students. Perhaps the more interesting of these discuss the relation of the marine alga *Ulva latissima* to the nitrogen content of the water in which it grows. The decay of this seaweed on the foreshores of the Lough was found to be the cause of the nuisance rather than the direct pollution of the water by sewage. At the request of the Royal Commission on Sewage Disposal, Prof. Letts, in collaboration with Dr.

W. E. Adeney, made an extensive survey of the more important estuaries around the British coasts, in order to obtain data on the question of standards for tidal waters in relation to offensive putrefaction and injury to fish. The results of this inquiry, together with much other relevant matter, were published in 1908 as an appendix to the Fifth Report of the Commission, and form a document of first importance, which has become classic in this branch of work. As the recognised authority on estuarine pollution, Prof. Letts took part in many Local Government Board inquiries and legal proceedings connected with his subject.

NOTES.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Charles Bolton, Henry C. H. Carpenter, Thomas A. Chapman, Gerald P. L. Conyngham, C. Clifford Dobell, Ernest Gold, Henry B. Guppy, Albert G. Hadcock, Archibald V. Hill, James C. Irvine, Thomas Lewis, Srinivasa Ramanujan, Arthur W. Rogers, Samuel Smiles, and Frank E. Smith.

THE meeting of the British Association, which it was hoped would be held in Cardiff this year, has been cancelled. The Local Committee has reluctantly decided that satisfactory arrangements could not be made to ensure success for the meeting, and has sent a resolution to that effect to the council of the association. The council has accepted this view, so that for two years in succession the annual assembly of workers in all departments of science will not take place. Sir Arthur Evans has consented to occupy the office of president for another year, and there will be a statutory meeting in London on July 5 to receive reports of committees and transact other business, but otherwise the corporate life of the association will continue in a state of suspended animation, though there never has been a more favourable time than now to make the nation realise the debt it owes to science for the successful conduct of the war and the need for unceasing scientific activity to prepare for the industrial struggle which the future must bring.

FOR the last three years the Royal Society of Edinburgh has adopted a new method for electing new fellows. The date of election is the first Monday of March of each year, and all candidates recommended by fellows must have their forms of recommendation sent in before the end of the preceding November. Since this improved method was adopted the general interest in the election has greatly increased, the number of new fellows each year varying from sixteen to twenty-one. At the meeting held on March 4 the following were elected fellows of the society:—D. Ballsillie, F. J. Blight, A. Bremner, J. M. Campbell, A. S. Dodd, T. L. Galloway, W. F. Gray, P. S. Hardie, J. R. L. Kingon, G. J. Lidstone, J. D. McCulloch, W. Mackie, W. P. Paterson, G. W. Tyrrell, C. Whyte, and J. T. Wight.

THE King has given orders for the appointment of Surgeon-General Sir Alfred Keogh, G.C.B., to the Order of the Companions of Honour for services in connection with the war.

WE regret to see the announcement in the *Morning Post* that Prof. P. Blaserna, Vice-President of the Senate, and professor of experimental physics in the University of Rome, died on February 26, at eighty-two years of age.

CAPT. J. C. MCWALTER, of Dublin, has been awarded the Carmichael prize of the Royal College of Surgeons in Ireland, value 100*l*., for an essay on the state of the medical profession.

THE triennial Henry Saxon Snell prize of the Royal Sanitary Institute, consisting of a medal and the sum of fifty guineas, will be awarded this year for an essay on "Suggestions for Improvements in Apparatus and Appliances for Dealing with House Refuse."

THE fourth Guthrie Lecture of the Physical Society of London will be delivered at 5 p.m. on Friday, March 22, at the Imperial College of Science, South Kensington, by Prof. J. C. McLennan, of the University of Toronto. The subject will be "The Origin of Spectra."

IT is stated in the *Times* that Capt. Roald Amundsen intends to leave Norway this summer in his new Arctic vessel *Maud*, which has been specially built for his attempt to reach the North Pole. The vessel is provisioned and fitted out for a seven years' stay in the ice, but Capt. Amundsen hopes to be back again within four years.

WE learn that last year the Imperial Museum of Natural History in Vienna began a new series of publications, the *Denkschriften*, to include larger works needing more extensive illustration than could be attempted in the well-known *Annalen*. The first volume is an important monograph by Dr. G. Schlesinger on the remains of Mastodon in the Vienna Museum, illustrated by thirty-five plates.

THE Geological Department of the British Museum (Natural History) has received as a gift from Mr. S. L. Wood two portions of Ichthyosaurus showing the skin and other soft parts, from the Lias of Barrow-on-Soar, Leicestershire. The skin of the paddle seems to have been ornamented with rosettes of dark spots. Among the stomach contents are hooklets from the arms of cuttle-fishes which have been eaten.

THE following officers and council of the Geological Society have been elected for the ensuing year:—*President*, G. W. Lamplugh; *Vice-Presidents*, R. M. Deeley, Dr. A. Harker, Prof. W. J. Sollas, and Sir J. J. H. Teall; *Secretaries*, Dr. H. H. Thomas and Dr. H. Lapworth; *Foreign Secretary*, Sir Archibald Geikie; *Treasurer*, Dr. J. V. Elsden; *Other Members of Council*, Dr. C. W. Andrews, Dr. F. A. Bather, Prof. J. Cadman, Dr. A. M. Davies, Prof. E. J. Garwood, J. F. N. Green, Dr. F. L. Kitchin, Major H. G. Lyons, Prof. J. E. Marr, R. D. Oldham, R. H. Rastall, Prof. H. H. Swinnerton, S. H. Warren, and Prof. W. W. Watts.

THE officers and members of council of the Institute of Chemistry for the ensuing year have been elected as follows:—*President*, Sir Herbert Jackson; *Vice-Presidents*, H. Ballantyne, W. T. Burgess, C. F. Cross, Sir J. J. Dobbie, Dr. A. Harden, and Sir Robert Robertson; *Hon. Treasurer*, A. G. Salamon; *Members of Council*, E. C. C. Baly, C. O. Bannister, Dr. O. L. Brady, H. C. H. Candy, A. C. Chapman, C. H. Cribb, Dr. J. T. Dunn, E. M. Hawkins, Dr. G. G. Henderson, P. H. Kirkaldy, H. G. Lacell, Dr. A. Lauder, J. H. Lester, F. J. Lloyd, W. Macnab, Prof. G. T. Morgan, D. Northall-Laurie, G. H. Perry, F. M. Potter, W. Rintoul, H. Silvester, G. Stubbs, Dr. J. F. Thorpe, T. Tickle, L. E. Vlies, E. White, and W. M. G. Young.

AN extension of the Fourth Northern General Hospital at Lincoln was opened on March 1 by

General Sir William Robertson, who, in the course of an address, pointed out the debt which the Army owes to medical science and skilful nursing. In past campaigns the mortality from sickness and epidemic disease was great, and was accepted as more or less non-preventable; but in the present war, with millions of men engaged in many different theatres of operations, some of them notoriously unhealthy, there has not been a single epidemic of any kind. The achievements of the Medical Service in this war constitute a bright spot on a picture which in many respects can be regarded only with sorrow and sadness.

A very important memorandum is issued by the Board of Agriculture and Fisheries as the second interim report of the Fresh-water Fish Committee. It deals with the economic value of the British eel fisheries, and deserves the widest publicity during the coming months. There are enormous runs of elvers in Great Britain and Ireland, so much so that many millions of these fish were formerly exported alive to Germany, for cultivation, from one catching depôt on the Severn. This depôt is now closed, and the Committee suggests that it should be taken over. The eel is the only popular fresh-water fish in these islands which is at the same time potentially highly abundant. The Committee is preparing schemes for intensive cultivation, now and after the war, and suggests the probability of a large export trade in the future. All persons interested in schemes of immediate eel culture should procure this report and advice from the Board of Agriculture and Fisheries (43 Parliament Street, London, S.W.1) or from the Fresh-water Fish Committee. The address of the secretary of the latter is the Hon. A. S. Northcote, 54A Parliament Street, London, S.W.1.

Many of the accepted ideas regarding the electric arc seem to be undergoing some revision. At the meeting of the Illuminating Engineering Society held on February 26 Lt.-Com. Haydn T. Harrison mentioned several interesting respects in which some of the latest high-candle-power arc searchlights differ from the older and simpler types. In the new lamps the intrinsic brilliancy attained is as much as 250,000–300,000 c.p. per square inch, as compared with 80,000–90,000, which was formerly considered the limit likely to be attained. It was pointed out by Mr. A. P. Trotter so long ago as 1892 that the candle-power in any direction from a flat arc crater can be determined with fair accuracy from Lambert's law, and that the polar curve of light distribution (neglecting the shadow cast by the negative carbon) is approximately a circle. This law is so definite that if photometric measurements, when plotted, yield a different curve it is proof that the source of light is not a plane surface, but convex. In the high-candle-power searchlight lamp developed during the last few years this phenomenon occurs despite the fact that there is a very deep crater. It therefore appears that the gaseous contents of the crater actually boil over, and thus change the plane surface into a convex-shaped source of light.

Dr. Hugo de Vries, professor of botany in the University of Amsterdam, has just completed his seventieth year. His long connection with the University has been marked by patient and successful investigations on "sporting" among plants, especially in *Oenothera Lamarckiana*, a plant which had become naturalised in Holland. His work with Œnothera began in 1895, and an article upon it appeared in Nature of November 26, 1908 (vol. lxxix., p. 101), when the Hortus Botanicus at Amsterdam was the subject of a contribution to our series of "Scientific Centres." Out of the work and the experiments that had led up to it the "mutation theory" of evolution originated and developed. Prof. de Vries gave an account of this theory and of his researches in the Masters memorial lectures, which he delivered before the Royal Horticultural Society in 1909 (he was the first Masters memorial lecturer), and his great book, "Die Mutationstheorie," has been ably translated into English by Prof. J. B. Farmer and A. D. Darbishire. The fundamental idea of unit characters upon which the whole argument rests has been at the back of almost all recent research into heredity in plants, and the development of Mendel's work, which had been so long overlooked, was prepared for, and aided not a little by, the researches de Vries made with Œnothera and other plants. This work has had a profound effect upon our outlook towards, and knowledge of, the origin and development of horticultural varieties of plants. In order to mark its appreciation of the great value of this work the council of the Royal Horticultural Society has conferred upon Prof. de Vries one of the Veitch memorial medals—a gold medal awarded only to those whose researches have had, or are likely to have, great influence in the advancement of horticulture.

An article in *La Nature* for February 16, under the title "Efficacité des Bombardements Terrestres et Aériens," is worthy of note. The writer remarks that the frequency of air raids has caused no little speculation as to the probability of personal danger during such raids. He proceeds to state the manner in which the laws of probability can be applied to estimate the chance of a shell falling at any particular spot near the target when the mean errors in range and direction are known. Turning to the question of bombardment from the air, figures are quoted from the *Aeroplane* giving the chances of a person receiving injury, and calculated on the assumption that a certain definite area surrounding the point of impact of a bomb is dangerous, and that bombs are equally likely to fall at any place in London. The results of these calculations were given in the *Aeroplane* as a table, which *La Nature* reproduces. The chance of danger is given as one in 150,000 in open spaces for each bomb dropped, while in a well-built house the chance is of the order of one in 50,000,000. These figures were based on the casualties during raids over London. One obvious weakness of the argument is that the bombs are not equally likely to fall anywhere, so that the danger is proportionately greater to those living near well-defined targets. The writer in *La Nature*, in applying these figures to Paris, expresses the opinion that the chances of injury are greater in that city than in London. He considers that the protection due to buildings has been over-estimated in the *Aeroplane*, especially if the buildings are not well constructed. The density of buildings is greater in Paris, and the houses are usually higher and more densely peopled. Making allowance for these facts, the French writer considers that the dangers in Paris are about twice as great as in London during an aerial bombardment.

Some remarks made in the House of Commons on February 21 by Sir Watson Cheyne, dealing with the question of "The Medical Aspect of Flying," or, as it would be more correctly described, "The Physiology of the Airman," have attracted wide attention. While all men of science would doubtless support the institution of a special service to devote attention to the troubles which happen to the airman on account of his ascent to high altitudes, it cannot be too strongly pointed out that the problem is essentially one for the physiologist. Naturally, the airman is liable to the numerous other ailments that beset us all, so that the air medical service requires the inclusion of men with a certain knowledge of these. But the most important aspect by far is a thorough acquaintance with all the various forms of distress induced by deficient supply of oxygen. It would seem to the layman, and apparently to many medical men also, a rather extraordinary thing that something which appears to concern respiration alone should produce vomiting, whereas the excellent work of Dr. J. S. Haldane and his collaborators, and of other physiologists also, has shown beyond question that the multitude of diverse symptoms caused by high altitude are results, simply and solely, of low oxygen tension. Sir Watson Cheyne is scarcely explicit enough here, and his statement that the lungs are primarily affected may easily be misunderstood. What is needed is a regular and periodic testing of the reactions of the airman to reduced oxygen pressure, and this by the accurate methods of the physiological laboratory. The nervous factors referred to by Sir Watson Cheyne require investigation at regular intervals by the expert experimental psychologist. The length of the reaction time is so obviously important that it needs no further reference. The effects on the nerve centres of repeated exposure to deficient oxygen need more experimental investigation. It is, however, satisfactory to find that more attention is being given to the preliminary testing of men destined for the Air Service.

AN editorial article entitled "Gunfire in France, Rainfall in England," by Dr. H. R. Mill, in the February issue of *Symons's Meteorological Magazine*, comprises an analysis of the monthly rainfall returns for the south-eastern and north-western districts of the British Isles for the wet period 1909–17, considered in subdivisions of two three-year peace-periods and one three-year war-period. The rainfall for each month and for both regions is given in percentage of the thirty-five-year average, 1875–1909, the stations utilised being those employed in "British Rainfall," as specially representative of the districts. Without exhibiting the data, it is impossible in the space at our disposal adequately to deal with the salient features of the investigation; suffice it to say that, in Dr. Mill's words, "they bear very strong evidence to the effect that the abnormalities of the rainfall of the war-years are merely the natural development of changes which have certainly been at work for nine years, and in one case no less certainly for fifty years." This last reference is to the increasing dryness of September, shown by Dr. Mill to have been a feature of the climatology of the British Isles during the past half-century, and is, indeed, a matter of common observation. Attention is directed to the noteworthy fact that not one of the four war Septembers has had so much as average rainfall. It is important, moreover, to observe that while 1915 and 1916 had both an excess rainfall of 21 per cent. in south-east England, 1917 (which certainly witnessed no relaxation in the activity of artillery) was a year of nearly normal fall (+4 per cent.). In the same number Mr. F. J. Brodie replies to those who have criticised his treatment in the issue of December, 1917, of the same problem, and incidentally suggests a statistical process by which he considers it might be possible definitely to decide the point at issue.

AT the annual general meeting of the Institute of Chemistry held on March 1, Sir James Dobbie, the retiring president, said that the past three years have afforded unusual opportunities for demonstrating the utility of the institute, and the special services which it has rendered in connection with the war have been widely acknowledged. It has done valuable work in introducing suitable candidates for commissions in his Majesty's Forces where technical knowledge and experience are required, and in providing chemists for Government factories, controlled establishments, and laboratories engaged in war work. Every public department and every branch of the fighting services that requires the aid of the chemist has made use of its services. The institute may fairly claim to have been the chief agent in mobilising the chemists of the country for war purposes. Since the beginning of the war the institute has been unremitting in its efforts to ensure to chemists a supply of pure reagents, glass, and porcelain. The value of the glass research work carried out under its auspices has been recognised on all sides, and investigations originally undertaken for purely chemical purposes have been extended for the benefit of nearly every branch of the glass industry. The attention of the council has been largely devoted to the revision of the regulations for admission to the membership of the institute, with the view of promoting complete organisation of British professional chemists. Sir James Dobbie hopes the institute will undertake to maintain a register for persons engaged in chemistry, but not necessarily qualified for admission as members. Such an organisation would make it possible, when occasion demanded, for the chemists of the country to bring their whole weight and influence to bear on questions of national interest.

WE have lately received from Messrs. Wood Bros. Glass Co., Ltd., Barnsley, a copy of their new catalogue of scientific and laboratory glassware, covering a considerable variety of useful chemical apparatus. When we recollect that three years ago the difficulty of securing supplies of such articles seriously menaced many industries connected with the prosecution of the war, and when we realise the difficulties which had to be overcome to establish this entirely new branch of industry—so far as this country is concerned—we may well congratulate the enterprising manufacturers who have made such a noteworthy endeavour to provide our chemists with these essential requirements. The production of chemical glassware presented many unusual problems for solution. In devising the formulæ for batch mixtures, Messrs. Wood Bros. and other firms have been assisted by the Glass Research Committee of the Institute of Chemistry; but they have had to provide special plant, machinery, and moulds, to determine the conditions of working, as well as to secure the services of workers possessing the necessary technical skill for making many articles of intricate design. With the increasing appreciation of the value of science in industry and the extension of science teaching in our schools, the demand for laboratory glassware is likely to be far greater than it has been in the past, and we hope that every encouragement will be given to the British makers who have achieved such success in spite of the serious obstacles with which they have been confronted. We hope, too, that it is thoroughly recognised by this time that this country must be able to supply its own needs in this direction, and that the industry must therefore be properly protected in order that it may become so well established here that there will be no inclination or necessity to look to other countries to provide us with anything of the kind. We shall look forward to seeing future issues of Messrs. Wood Bros.' catalogue, and anticipate that in the course of the present year the range of production will be substantially extended.

IT is a matter of common experience in the fattening of cattle that the gain in live-weight secured per unit of feed consumed diminishes as the fattening progresses. Of the various causes that may contribute to this result the one that is perhaps most commonly regarded as being mainly responsible is the supposed less efficient utilisation of feed by the fattened as compared with the thin animal, the unit of a resorbed nutrient producing, according to this view, less fat in the latter case, while the heat production of the body should be correspondingly greater. In order to test this view by a direct comparison of the utilisation of feed energy by the same animal in ordinary condition and when well fattened an investigation has been carried out by Messrs. H. P. Armsby and J. A. Fries at the Institute of Animal Nutrition of the Pennsylvania State College, the results of which are published in the *Journal of Agricultural Research*, vol. xi., No. 10. No difference was found in the efficiency of digestion of the food by the animal in lean or fat condition, nor was there any measurable difference in the percentage of the gross energy of the feed which was metabolisable. The heat increment resulting from the consumption of a unit of feed was but little greater, and consequently the net energy value of the feed but slightly less, in the fattened than in the unfattened condition. The increased maintenance requirement of the fattened as compared with the lean steer was greater than corresponded with the increase in weight or in computed body surface. The lower economic efficiency of the fattened animal in this experiment was thus due chiefly to his higher maintenance requirement, and only to a small extent, if at all, to a difference in the utilisation of the surplus of feed above the maintenance requirement.

A NEW instrument for the determination of sea-water densities on board ship is described by Mr. A. L. Thomas in the Journal of the Washington Academy of Sciences for December 19, 1917 (vol. vii., No. 21). It is a modification of the total immersion hydrometer, and consists essentially of a test-tube containing the float, or bobbin, and the liquid to be measured, a stirred variable temperature bath, and a thermometer. The bobbin is about 5 cm. long and 12 mm. in diameter, and is made of Jena glass. The glass test-tube holds 15 to 30 c.c. of the water to be tested. The temperature bath, of copper and glass, holds about 270 c.c. of water, and can be rapidly heated electrically. The method of making a determination depends on noting the precise temperature at which the liquid to be tested is exactly of the same density as the bobbin, which is, of course, when the bobbin neither sinks nor rises. By taking the mean of the readings approaching the equilibrium temperature from a higher and a lower temperature the result may be obtained to 0·05° C. It is claimed that the apparatus is simple and rapid to work, requires a small amount of the water to be tested, and gives accurate results.

IN the paper on "Switchgear Standardisation" which Dr. C. C. Garrard read to the Institution of Electrical Engineers on February 21 many subjects were discussed which are of special interest at the present time. In connection with research, Dr. Garrard pointed out that while the Department of Scientific and Industrial Research expends a few hundred pounds on "switching and arcing," a single Berlin firm had recently expended about a hundred times as much in building a laboratory for the specific purpose of testing oil switches alone. He suggests that the electrical industry and the Government should co-operate for the purpose of providing a national high-tension research and standardising laboratory. We see no reason, however, why existing laboratories should not be utilised in the first place to the fullest possible extent. Several grandiose schemes on a similar scale have been discussed by various committees recently. They all start with the assumption that generous financial support will be given by the Government. In the discussion several speakers pointed out that standardisation has its limitations. It would be foolish, for instance, to standardise devices which are being improved from day to day. Such a procedure would simply mean the placing of an embargo on invention. Mutual co-operation is in every way desirable, but when interests are antagonistic it cannot be obtained. To force private firms to pool their information for the general good would in many cases simply amount to confiscation of capital; it is only human that manufacturers should desire to keep their trade secrets. The question also as to how far it is desirable to make devices "fool-proof" was discussed. The general opinion was that the great series of campaigns originated in America with the cry of "safety first" has now gone too far. To expend ingenuity in making devices "fool-proof" is desirable, but to try to make them absolutely "fool-proof" is in many cases pure waste of time.

FROM the specific gravities of certain substances, that of water at different temperatures, and those of the solutions of these substances in water, Mr. J. N. Rakshit has calculated the contraction of volume resulting when a fixed quantity of each substance is dissolved in increasing quantities of water. The results are tabulated in the Proceedings of the Indian Association for the Cultivation of Science (vol. iii., part iv.), the substances dealt with being hydrochloric, sulphuric, nitric, formic, acetic, and tartaric acids; stannic and sodium chlorides; ammonia, sodium, and potassium hydroxides; methyl, ethyl, propyl, *iso*butyl and *iso*amyl alcohols, glycerol, phenol, dextrose, lævulose, maltose, invert- and cane-sugars, acetone, chloral hydrate, acetonitrile, and nicotine. Study of the figures obtained shows that in some cases the contraction of volume increases with the increase in dilution, but in several others as the dilution increases a point of maximal contraction is observed. The maximum contractions are constants, and different for different substances. In the cases of sodium chloride and of acetic and sulphuric acids the contraction of volume at all dilutions diminishes as the temperature rises. It is not yet known whether this phenomenon is due to differences in the coefficients of expansion of water and of the solute.

A NEW book by Sir Ray Lankester is being brought out by Messrs. Methuen and Co., Ltd., entitled "Secrets of Earth and Sea," in which the following subjects will be dealt with:—The mammoth as drawn by those who lived with it; the "rostro-carinates"—the earliest works of man; Vesuvius in eruption; pond-life; gregarines and malaria; a mere worm (the earth-worm); what is meant by a species; the classification of animals; geological strata; about fishes (flying-fish, climbing-fish, blind-fish, cave-fish, deep-sea fish); the races of man; Darwinism and war; German culture; spider-sense and nonsense; belief and evidence; the Svastika. Other books in Messrs. Methuen's new list are:—"Glossary and Notes on Vertebrate Palæontology," the Rev. S. A. Pelly; "The Fisheries of the North Sea," N. Green; and "Food and Garden," H. A. Day.

CATALOGUE No. 71, just issued by Messrs. Dulau and Co., Ltd., 37 Soho Square, W.1, contains particulars of books and papers from the library of the late Dr. A. M. W. Downing, and other sources. It refers in the main to works on astronomy and astrophysics, but also gives the titles of books relating to engineering, geology, and mathematics.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET AND OTHERS.—Encke's comet was observed by Mr. R. Jonckheere at Greenwich Observatory on March 1. It appeared as a large diffused nebulosity of magnitude $8\frac{1}{2}$, without visible nucleus or tail. The position accorded well with the ephemeris lately given in NATURE. The brightness is now increasing, but the comet is drawing too near the sun for convenient observation.

A very interesting object, in appearance resembling a minor planet, but with an orbit of a cometary character, has been discovered by Prof. Wolf at Heidelberg. The following positions have been received:—

G.M.T. 1918 d. h. m.	Appt. R.A. h. m. s.	Appt. N. Decl. ° ′ ″	Place
Jan. 3 9 40·0	5 16 30	12 29 0	Heidelberg.
Feb. 5 8 37·5	6 56 9·47	34 19 19	,,
11 18 28·1	7 17 43·22	35 55 21	Lick Obs.

The magnitude was 11 on January 3; 11·5 on February 3. The distance from the earth was about twenty-three million miles. The orbit appears to be a highly eccentric ellipse, with perihelion slightly outside the earth's orbit. The object will be below the 12th magnitude in March, so will only be observable by photography. Prof. Wolf announced a satellite of the 14th magnitude at a distance of 340″, moving through 13° per hour. It is impossible that the object could be massive enough to control a satellite at that distance, with such rapid motion, so it was probably a faint minor planet that happened to pass in the same line of sight.

Mr. Knut Lundmark, of Upsala Observatory, has deduced the following definitive orbit of the comet of 1802 (Pons) (*Arkiv för Matematik, Astronomi och Fysik*, Bd. 12; No. 13). It was under observation from August 25 to October 6 last.

$$\begin{array}{l} T\ \ 1802 \text{ Sept. } 9{\cdot}8619 \text{ Paris M.T.} \\ \left.\begin{array}{ll} \omega & 21^\circ\ 52'\ \ 7'' \\ \Omega & 310^\circ\ 14'\ 18'' \\ i & 56^\circ\ 59'\ 30'' \end{array}\right\} 1802{\cdot}0 \\ \log q\ \ 0{\cdot}0391162 \end{array}$$

A list is given of other comets with somewhat similar elements, including comet 1909 I. In no case, however, is identity probable.

NEBULOSITY ABOUT NOVA PERSEI (1901).—Photographs taken with the 60-in. reflector at Mt. Wilson have shown very clearly the nebulosity surrounding Nova Persei, which was discovered by Barnard in December, 1916 (Journ. R.A.S. Canada, vol. xii., p. 25). The strongest condensations are south preceding the nova, and give a fan-shaped appearance to the nebulosity on that side, somewhat resembling that which accompanied the original outburst. A negative taken by Mr. Ritchey on December 16, 1917, shows, in addition, a sharply defined continuous ring of nebulosity about 16″ in diameter, with the nova at its centre. If this ring be the result of the sudden increase in brightness of the nova ($1\frac{1}{2}$ magnitudes) reported by Belopolsky in August last year, it may be analogous to the expanding rings observed in 1901–2, but on a much smaller scale.

THE EGYPTIAN GOVERNMENT ALMANAC.—Owing to shortage of paper, the Egyptian almanac for 1918 has been issued in the form of a pamphlet, which is to be regarded as a supplement to the 1917 edition. The two pages assigned to each month give the Julian, Arabic, Coptic, and Jewish dates; fasts, festivals, and remarkable days; the times of rising and setting of the sun and moon at Cairo; and particulars of the phases of the moon and the visibility of the planets. The publication will doubtless be a great convenience to those for whom it is intended.

SIR ALFRED KEOGH AND THE ARMY MEDICAL SERVICES.

THE reception held at the Imperial College of Science and Technology on February 27, to welcome Sir Alfred Keogh back to the college of which he is rector, was entirely a domestic function. But the occasion made it, as Lord Crewe, who presided, said, a red-letter day in the history of the college. For three and a half years Sir Alfred Keogh, in response to Lord Kitchener's request, has refilled his former post of Director-General, and succeeded in getting this all-important Department into such working order that he is able to hand it over with safety to another; and the Imperial College has its rector back again. At this reception speeches were made by Lord Crewe, by Mr. Acland, and by Prof. Farmer, but by far the most important address was that made by the rector himself. One passage of this is of supreme importance, not only as embodying the result of his long and wonderful experience, but also as indicating the principles which have guided him in the work of the great Department over which he presided with such distinction and with such notable advantage to his country; it is, moreover, a writing on the wall for the admonition and guidance not only of the Army Medical Department, but also of all other departments. The rector said:—

"I hold, and always have held, that in this country, and perhaps in this country alone, administration has been absolutely divorced from science, that the administrator, as a rule, is ignorant of any particular branch of science, that he has had, as a rule, no scientific training, and neither thinks nor acts scientifically. I attribute many of our national shortcomings to this fact. If I have accomplished those things which you say I have in my official service, it has been because I have, from the first, both in matters of science and of administration, relied entirely upon scientific men, and have refused to take into my counsels other classes of administrators. To have done so would have been to have given the lie to the principles I have held for so many years."

It is devoutly to be hoped that these piercing words will not fall entirely upon stony ground, but that they will sink deeply into the nation's mind. Sir Alfred Keogh is, like all really great men, an artist, and is therefore possessed of imagination—one of the rarest of gifts; and, although in these words of his he modestly speaks of relying upon men of science, he has in him that scientific spirit which can guide and control the imagination or creative spirit. It is this union of imagination with the scientific spirit, coupled with his belief in the value of science, which has been the secret of Sir Alfred Keogh's notable success in the creation and direction of the Army Medical Services; for the R.A.M.C. of to-day is a new creation. The idea of bringing science to bear practically on such an unpromising thing as the military medicine and surgery of fifty years ago was a very bold conception, the value of which is now apparent to the lay mind through the publication of the numbers of cases of disease in this campaign as compared with any that have gone before.

It is worth while at the present moment to recall a few of the advances made by Sir Alfred Keogh; the real, detailed history of the steps will have to be written later. During the South African War he was placed upon the Committee for the Reorganisation of the Army Medical Service, which was created by Mr. Brodrick, and he afterwards became Deputy-Director-General and later Director-General. One of his early feats, of a more or less ethical kind, was the adjustment of the proper relations between the doctor of the regiment and its commanding officer, which altered the status of the doctor and placed responsibility in the right place. No advance was possible until this readjustment had taken place. He was associated with the scheme for the formation of the Advisory Board, consisting of military men and of civil and military medical men, upon a much broader basis than the system which the Board displaced. At this time there was an Army Medical School at Netley, where certain things only could be learnt, but there was no place where a man could go in order to brighten up rusty or deficient knowledge, or to learn what was new in medicine or surgery since he qualified. A scheme was then in progress, and money had been voted for the purpose of enlarging Netley, but Sir Alfred Keogh saw at once that such a place ought to be in London, and at his instigation the Netley extension was stopped and the Netley school boldly brought to London. At first it was housed temporarily in the laboratories of the Colleges of Physicians and Surgeons, but he saw that, as the Millbank Military Hospital was being built, the right place for his school would be near to it, and so the Royal Army Medical College was built with all the necessary arrangements for post-graduate teaching and training and for research work, and with facilities for acquiring new knowledge in any branch. Sir Alfred Keogh was also the first Director-General to encourage research among the better men of the R.A.M.C., and it was through his influence that such men as the late Major Fry and Capt. Ranken, V.C., were encouraged and permitted to undertake research work for the Royal Society, with results sufficient to justify publication in the Proceedings of the Royal Society.

When Sir Alfred Keogh became Deputy-Director-General there was no special sanitary service in the Army, and the knowledge of sanitation and hygiene, and of all that these words connote, which was possessed by the doctors was of the most elementary kind. He saw that if this were not rectified there would be a terrible and unnecessary loss of life in the next war, and he set himself to draw up a scheme by which a special branch of the Army Medical Service, devoted to sanitary science, should be created. He also insisted that the principles of sanitary science should be taught to the military students as a part of their ordinary course, as well as to the members of the R.A.M.C., and even to the combatant officers; a School of Army Sanitation was founded, and directors of Medical Sanitary Service were provided for the armies in the field, and a sanitary officer was placed on the staff of each command. This scheme had to wait years for its realisation, and it is to the credit of Lord Haldane that it was owing to his initiative and support that it became law. It is the application of science to sanitation which has helped in a very great measure to reduce the incidence of disease in the present war to the remarkable figures which have been published. Bound up with this is the question of water supply to the troops, and a branch of the Medical Service has had special instruction in the examination and disinfection of water, thus ensuring a safe and wholesome supply. Sir Alfred Keogh also initiated and superintended a long series of experiments on the kind and quantity of food necessary for soldiers, and as the result a system of food-rationing was arrived at which has, with but few modifications, borne the very severe test of the present war. His attitude towards vaccine therapy shows the same scientific perception. In the South African War many accidents happened owing to our incomplete knowledge of the subject, so he appointed a committee of experts, presided over by Sir W. Leishman, who wrote, as the result of the inquiry, the historical paper which has been the foundation of our present effective and safe methods.

In all these ways Sir Alfred Keogh prepared the way for the extraordinary results which have followed our treatment of typhoid fever and other diseases by vaccines in the present war; and during the war he has also exercised the same vigilant control by attacking two other diseases in the same scientific spirit—namely, tetanus and trench fever. Tetanus is a rare disease in peace-time, but during the war such numbers of cases occurred that he decided to form a committee for the *study* of this disease, which, as a result of its researches, would be able to advise as to better methods of treatment, and this has been followed with the best results. He has also formed a committee for the study of the problems of trench fever, which has already achieved important results. In both these cases, besides practical results, our scientific knowledge of the disease has been advanced: he has therefore, in all these instances, helped towards making medicine the possibly scientific pursuit which it is always becoming.

In addition, Sir Alfred Keogh had for two and a half years the direction of the work on poison gas and gas attacks, which work has been of no small advantage to us. But it is rather in the greater work of saving life that his devotion will be remembered, and the country can never forget what it owes to him in this respect. To have reduced disease to a minimum, so that men are more healthy in the field than at home; to have organised a medical service sufficient for our enormous Army, scattered all over the world; to have devised and insisted upon methods of sanitation which have borne the strain of most difficult conditions; to have encouraged and insisted upon research, even during the war, into diseases which have become prominent and about which we know little, forms a record which no mere words can appraise. It is not only that he has done these things, but also that he has done them in the face of great opposition, from both the military and the medical side. His power of imagination, however, controlled by the scientific spirit, has enabled him not only to overcome all the difficulties he has had to face, but also to hand over to another a living machine, which he knows will still act with the spirit he has infused into it, and be capable of answering any calls that may be made upon it.

It is not possible here to speak of Sir Alfred Keogh's work at the Imperial College of Science. There is no doubt that the college has caught something of his spirit, for it has given all its energies in every department to the service of its country, as Sir Alfred Keogh himself did.

His example will live; let us hope that his words, quoted above, may not be forgotten; may they be, as the Preacher said the words of the wise were, "as goads and as nails driven deep in." H. G. P.

THE DEPARTMENTAL REPORT ON SALARIES IN ELEMENTARY SCHOOLS.

In view of the important changes that are foreshadowed in the sphere of education in the Bill now before Parliament, the question of a due supply of efficient teachers, especially for the elementary schools, assumes an aspect of high importance. We therefore welcome the carefully considered report, just issued, of the Departmental Committee for inquiring into the principles which determine the construction of scales of salary for teachers in elementary schools (Cd. 8939, price 6*d*. net).

The Committee, of which Sir Harry Stephen was chairman, was comprised of representatives of the various interests concerned—administrative and educational—and it received, either personally or by memorandum, the evidence of fifty-six witnesses representative of all shades of opinion and conditions of experience, with the result that a report of sixty-three folio pages of high value has been prepared, which will do much to enhance the position of the teacher. "For many years past," the report states, "it has not been possible to secure recruits in numbers adequate to the needs of the schools." The position will obviously be seriously aggravated should Mr. Fisher's Bill become law, and the children be required to remain at school until fourteen, and continued education be imposed within the usual hours of labour until the age of eighteen is reached. Not only will a much larger number of teachers be required, but also teachers of higher qualifications.

Already there are in the elementary schools 167,810 teachers of all grades, of whom 43,500 are men and 124,310 are women. Of this number 109,250 are trained certificated teachers. There is a constant pressure to induce a still larger number of teachers to go through a course of two or more years of college training with the view of securing either a certificate or a degree, which means that the future teacher will be at least twenty-one or twenty-two years of age before remunerative employment begins, and that on a scale not higher than that of an ordinary artisan.

It will be seen from the above figures how large a proportion of the elementary-school teachers are women, and yet it is clear that, at least for the older boy pupils, it is most desirable that their teachers should be men. The question of a more abundant recruitment is of vital moment, and its solution lies not merely in the establishment of a higher scale of salaries and an adequate pension scheme, but also in better prospects for the more able of the teachers, so that not only should head-teacherships be open to them, the average salary of which in England and Wales is about 176*l.* for men and 126*l.* for women, but also inspectorships and administrative posts with the central and local authorities.

It cannot be expected that men trained side by side in the same university with prospective lawyers, doctors, divines, men of science, and technologists in industry and commerce seeking degrees of equivalent standing will be content with the poor rewards the profession of teaching in the elementary schools offers to able men. If the nation desires that its children shall have a prolonged and satisfactory education in well-equipped schools, and also the best possible training at the hands of capable teachers, there is no course open to it but to pay the price for this essential service, and the reward of the nation will be great.

The report, in its interesting analyses and tables, exhibits an astonishing variety of scales of payments and of increments prevailing in the various areas, urban and rural, of England and Wales, but only in few cases can they be said to be liberal or attractive. There needs to be more uniformity than at present exists in the salaries of teachers, and where the produce of a 1*d.* rate per child is low, then it would appear desirable that the central authority, in order that the teacher may not suffer, should give the necessary financial assistance. Based upon the minimum initial salary which the President of the Board of Education stated that he had in mind, namely, 100*l.* for men and 90*l.* for women, the report offers, by way of illustration, five separate scales, according to the varying circumstances of urban and rural areas, for men and women certificated class teachers, ranging from 100*l.* and 90*l.* respectively to 300*l.* and 240*l.*, the maximum varying according to the conditions of the area, and for head-teacherships a like set of illustrative scales, rising to 400*l.* in the case of men and to 300*l.* in that of women, the maximum again to be determined by local conditions.

The principles insisted on in the report are that there should be a reasonable initial payment, and a scale of increment leading to a point representing an adequate salary; that this should be receivable as a matter of right, and as part of the contract, by every teacher whose service is not characterised by definite default or wilful neglect; and that, in order that the increment should be so adjusted as to meet the teachers' needs, the value of the teachers' services should be periodically recognised, so that good service may be encouraged. With respect to the payment of women teachers, the report states that in the opinion of the Committee the scale of salaries adequate for women is inadequate for men, and that in average circumstances the maximum for women should be three-fourths that for men, and finally suggests that the best method of recognising superior merit in teachers is by advancement to positions of greater responsibility and increased emolument, even if it means a departure from the normal scale.

The report is accompanied by a valuable memorandum, drawn up by its secretaries, giving a retrospect of methods and scales of payment since the Act of 1870, and a clear account, illustrated by elaborate comparative tables, of the common features of existing scales in various parts of the country.

METEOROLOGY AND EXACT THERMOMETRY.

IN the *Monthly Weather Review* for November, 1917, Prof. C. F. Marvin, Chief of the U.S. Weather Bureau, asks for a short word and corresponding symbol for the temperature on the hydrogen- or adjusted mercury-scale of Centigrade degrees measured from 273° C. below the normal freezing point of water in place of the word *absolute*. As he rightly points out, the use of the word in that sense is loose scientific language, because, to those who know, it means not quite the same thing as the absolute thermodynamic scale or true Kelvin scale.

Prof. Marvin's own suggestions for a descriptive name are *quasi-absolute, approximate absolute,* and *pseudo-absolute,* not one of which is likely to appeal to the general reader as the *mot juste*. The question is one of practical importance, because our own Meteorological Office uses the approximate absolute scale in many of its publications for expressing temperatures, together with the millibar scale for pressure, notably in its recent issue of data for the whole world with the title of *Réseau Mondial*. It has discarded the use of the degree sign for temperature and uses a small **a** immediately after the numeric, thus placing temperature on the same footing as an ordinary physical quantity like mass or length.

The practice of using absolute c.g.s. units for pressure and the approximate absolute scale for temperature dates from 1909 with the regular publication of data of the upper air in the *Weekly Weather Report*, and afterwards in the *Geophysical Journal*, the only change being the adoption of the millibar instead of the megadyne per square centimetre in 1914, a practice against which Prof. McAdie, of Harvard University, has raised protests on the ground that chemists had already assigned another meaning to the word *bar*. In the same year the U.S. Weather Bureau commenced the issue of a daily map of the northern hemisphere in the same units. The millibar was adopted in France for the *Bulletin International* in 1917.

The history of scientific progress justifies some looseness in the use of language. For example, the "boiling point of water" as a thermometric fixed point, like the "absolute" scale of temperature, is a loose expression, only understood by those who know; and unless some looseness be permitted the measurement of the "specific heat of copper" would have to disappear from the elementary course. With the two exceptions mentioned, the adoption of "absolute" units for atmospheric measurements, which was not "made in Germany," has been received with profound indifference in scientific circles. But the whole question of units and their nomenclature is of great importance to us at this juncture. Our practice of using one set of units in the laboratory and another set in practical life can only be described as stupid. Although the particular point raised is not a crucial one, it is much to be desired that Prof. Marvin's note may be the beginning of the serious consideration of this important subject by the exponents of the physical sciences.

GRAVITATION AND THE PRINCIPLE OF RELATIVITY.[1]

THERE were many difficulties to encounter in entering the room just now. To begin with, we had to bear the crushing load of the atmosphere, amounting to 14 lb. on every square inch. At each step forwards it was necessary to tread gingerly on a piece of ground moving at the rate of twenty miles a second on its way round the sun. We were poised precariously on a globe, apparently hanging by our feet, head outwards into space. And this acrobatic feat was performed in the face of a tremendous wind of æther, blowing at I do not know how many miles a second literally through us. We do not claim much credit for overcoming these difficulties—because we never noticed them. But I venture to remind you of them, because I am about to speak of some other extraordinary things that may be happening to us of which we are quite unconscious.

Not to go too far back in history, the present subject arises from a famous experiment performed in the year 1887, known as the Michelson-Morley experiment. The apparatus was elaborate, but the principle of the experiment is not very difficult. If you are in a river, which will be the quicker—to swim to a point fifty yards up stream and back again, or to a point fifty yards across stream and back again? Mathematically the answer is, perhaps, not immediately obvious, because the net effect of the current is a delay in both cases. But I think that anyone who has swum in a river will have no hesitation about the answer. The up-and-down journey takes longer. Now we *are* in a river—of æther. There is a swift current of æther flowing through this room; or, if we happen to be at rest in the æther at the present moment, six months hence the earth's orbital motion will be reversed, and then there must be a swift current. Michelson divided a beam of light into two parts; he sent one half swimming up the stream of æther for a certain distance, and then by a mirror back to the starting point; he sent the other half an equal distance (as he thought) across the stream and back. It was a race; and with his apparatus he could test very accurately which part got back first. To his surprise, it was a dead-heat. Clearly the two paths could not really have been equal, the along-stream path must have been a little shorter to compensate for the greater hindrance of the current. That objection was foreseen, and the apparatus, which was mounted on a stone pier floating in mercury, was rotated through a right angle, so that the arm which was formerly along the stream was now across the stream, and *vice versa*. Again the two portions of the beam arrived at the same moment; so this time the other arm had become the shorter—simply by altering its position. In fact, these supposedly rigid arms had contracted when placed in the up-and-down stream position by just the amount necessary to conceal the effect which was looked for.

[1] Discourse delivered at the Royal Institution on Friday, February 1, by Prof. A. S. Eddington, F.R.S.

That is the plain meaning of the experiment; but we might well hesitate to accept this straightforward interpretation, and try to evade it in some way, were it not for some theoretical discoveries made later. It has gradually appeared that matter is of an electrical nature, and the forces of cohesion between the particles, which give a solid its rigidity, are electrical forces. Larmor and Lorentz discovered that this property of contraction in the direction of the æther current was something actually inherent in the formulæ for electrical forces written down by Maxwell many years earlier and universally adopted; it only waited for some mathematician to recognise it. It would be going too far to say that Maxwell's equations actually prove that contraction must take place; but they are, as it were, designed to fall in line with the contraction phenomenon, and certain details left vague by Maxwell have since been found to correspond.

We are then faced with the result that a material body experiences a contraction in the direction of its motion through the æther. According both to theory and experiment the contraction is the same for all kinds of matter—a universal property. One reservation should be made; the experiment has only been tried with solids of laboratory dimensions, which are held together by *cohesion*. There is at present no experimental evidence that a body such as the earth the form of which is determined by *gravitation* will suffer the same contraction; we shall, however, assume that the contraction takes place in this case also.

I am going to ask you to suppose that we in this room are travelling through the æther at the rate of 161,000 miles a second, vertically upwards. Let us be bolder and say that that *is* our velocity through the æther—because no one will be able to contradict us. No experiment yet tried can detect or disprove that motion; because all such experiments give a null result, as the Michelson-Morley experiment did. With that speed the contraction is just one-half. This pointer, which I hold horizontally, is 8 ft. long. Now [turning it vertically] it is 4 ft. long. But, you may say, it is taller than I am, and I must be approaching 6 ft. No, if I lay down on the floor I should be, but as I am standing now I am under 3 ft. The contraction affects me just as it did the pointer. It is no use bringing a standard yard-measure to measure me, because that also will contract and represent only half a yard. "But we saw that the pointer did not change length when it turned." How did you tell that? What you perceived was an image of the pointer on the retina of your eye, and you thought the image occupied the same space of retina in both positions; but your retina has also contracted in the vertical direction without your knowing it, so that your estimates of length in that direction are double what they should be. And similarly with every test you could apply. If everything undergoes the same change, it is just as though there were no change at all.

We thus get a glimpse of what, from our present point of view, must be called the *real* world, strangely different from the world of appearance. In the real world, by changing position you extend yourself like a telescope; and the stoutest individual may regain slimness of figure by an appropriate orientation. It must be something like what we see in a distorting mirror; and you can almost see a living-picture of this real world reflected in a polished door-knob.

If our speed through the æther happens not to be so great as we have supposed, the contraction is smaller; but it escapes notice in our practical life, not because it is small, but because from its very nature it is undetectable. And because this real world is undetectable we do not as a rule attempt to describe it. Not merely in everyday life, but in scientific measurements also, we describe the world of appearance. We do this by imagining natural objects to be placed, not in the absolute space, but in a quite different framework of our own contriving—a space which corresponds with appearance. In the space of appearance a rod does not seem to change length when its direction is altered; and we use that property to block out our conventional space, counting the length occupied by the standard yard-measure as always a yard however its true length may vary. It is found also that in like manner our time is a special time of our own, different from the time we should adopt if our motion through the æther were *nil*. This is a perfectly right procedure; it introduces no scientific inexactness, and it is more in accordance with the ordinary meaning attached to space and time; the only thing to remember is that this space and time framework is something peculiar to us, defined by our motion, and it has not the metaphysical property of absoluteness, which we have often unconsciously attributed to it.

Now let us visit for a moment the star Arcturus, which is moving relatively to us with a velocity of more than 200 miles per second. Consequently its motion through the æther is different from ours, and the contraction of objects on it will be different. It follows that our conventional space would not be suitable for Arcturus, because it was specially chosen to eliminate our own contraction effects. There is a different space and a different time proper to Arcturus. We must then imagine each star carrying its own appropriate space and time according to its motion through the æther. The space and time of one star will not fit the experience of individuals on another star.

The exact relation between the appropriate space and time of one star and the space and time of another was first brought out clearly by Minkowski; it is a very remarkable one. We recognise three dimensions of space, which we may take as up-and-down, right-and-left, backwards-and-forwards. If we go over to Ireland we still have the same space, but Ireland's up-and-down no longer corresponds with ours. The directions are inclined; and what is vertical to them is partly vertical and partly horizontal to us. Now let us add a fourth dimension, imaginary [2] time, at right angles to the other three. There is no room for it in the model, but we must do our best to imagine it in four dimensions. In Ireland the three space-dimensions will have rotated, as I have said; but the time will be just the same. But if we go to Arcturus, or to any body moving with a velocity different from our own, the time-dimension also has rotated. What is time to them is partly time and partly imaginary space to us. It is a change in the space-time world of four dimensions just analogous to the change in the space-world between here and Ireland. That is Minkowski's great result; space-time is the same universally, but the orientation—the resolution into space and time separately—depends on the motion of the individual experiencing it, just as the resolution of space into horizontal and vertical depends on his situation. In Minkowski's own famous words—"Henceforth Space and Time in themselves vanish to shadows, and only a kind of union of the two preserves an independent existence."

From our original point of view it seems very remarkable that in the Michelson-Morley experiment the contraction should have been of just the right amount to annul the expected effect of our motion through the æther. Many other experiments, which seemed likely to show such an effect, have been tried since then, but in all of them the same kind of compensation takes place. It looks as though all the forces of Nature had entered on a conspiracy together with the one design of preventing us from measuring or even detecting our motion through the æther. It is still an open question whether one force, the force of gravitation, has joined the conspiracy. Hitherto gravitation has stood aloof from all the other interrelated phenomena in majestic isolation. We have become almost reconciled to leaving it outside every physical theory. A new model of the atom is put forward which accounts for a whole host of abstruse and recently discovered properties; but it would be considered unfair to suggest that it ought to account for the simple and universal property of gravitation. Dare we think that gravitation has so far forgotten its dignity as to join this conspiracy? There is certainly not enough evidence for a jury to convict; but yet I think we shall have to intern it on suspicion. Recently Sir Oliver Lodge, believing that gravitation was innocent of the conspiracy, showed that a very famous astronomical discordance in the motion of Mercury might be an effect due to the sun's motion through the æther, and might afford a means of estimating its speed. It is difficult in a brief reference to deal quite fairly with an intricate question, but it seems now that we should rather lay stress, not on this single discordance, which can perhaps be otherwise explained, but on the exact agreement of Venus and the earth with theory; for they also should show evidence of the sun's motion through the æther if gravitation had not joined in the conspiracy to conceal all such effects. It may be that the effects on Venus and the earth are not found because the sun's motion through the æther happens to be very small; but on the whole it appears more likely that the effect of the motion is null, just as in the Michelson-Morley experiment, because there is a complete compensation in the law of gravitation itself.

The great advantage of Minkowski's point of view is that it gets rid of all idea of a conspiracy. You cannot have a conspiracy of concealment when there is nothing to conceal. We cut Minkowski's space-time world in a certain direction, so as to give us separately space and time as they appear to us. We have been imagining that there exists some direction which would separate it into a real and absolute space and time. But why should there be? Why should one direction in this space-time world be more fundamental than any other? We do not attempt to cut the space-world in a particular direction so as to give us the *real* horizontal and vertical. The words "horizontal" and "vertical" have no meaning except in reference to a particular spot on the earth. So for a particular observer the space-time world falls apart into its four components, up-and-down, right-and-left, backwards-and-forwards, sooner-and-later; but no observer can say that this division is the one and only real one.

Our idea of a real space more fundamental than our own was, however, not entirely metaphysical; we had materialised it by filling it with an æther supposed to be at rest in it. We now deny the existence of any unique framework of that kind. We have failed to obtain experimental knowledge of such a framework since we cannot detect our motion relative to it. Whatever may be the nature of the æther, it is devoid of those material properties which could constitute it a

[2] Imaginary in the mathematical sense, *i.e.* involving $\sqrt{-1}$. It is much simpler to consider imaginary time; and throughout the lecture I have ventured to omit reference to the complications which arise when our results are restated in terms of real time.

framework of reference in space. We can perhaps best picture the æther as a four-dimensional fluid filling uniformly Minkowski's space-time *continuum,* not as a material three-dimensional fluid occupying space and time independently.

The position we have now reached is known as the principle of relativity. In so far as it is a physical theory, it seems to be amply confirmed by numerous experiments (except in regard to gravitation). In so far as it is a philosophical theory, it is no more than a legitimate and useful point of view. I now pass on to a generalised principle of relativity, in which we must be content at first to be guided by a natural generalisation of these results, hoping later to be able to check our tentative conclusions by experiment.

If we analyse any scientific observation, distinguishing between what we perceive and what we merely infer, it always resolves itself into a *coincidence* in space and time. A physicist states that he has observed that the current through his coil is 5 milliamperes; but what he actually saw was that the image of a wire thrown by his galvanometer *coincided* with a certain division on a scale. He measures the temperature of a liquid, but the observation is the *coincidence* of the top of the mercury with a division on the thermometer. If then we had to sum up the whole of our experimental knowledge, we should have to describe it as consisting of a large number of coincidences.

A complete history of the progress of a particle consists of a knowledge of its path and the time at which it occupied each point of the path. The time may be regarded as an extra co-ordinate corresponding with a fourth dimension, and so the whole history may be summed up by a line in four dimensions representing the particle's progress through space and time. We call this four-dimensional line the *world-line* of the particle. Imagine that we have drawn the world-lines of all the particles, light-waves, etc., in the universe: we shall then have a complete history of the universe. It will be a rather dull history-book; the Venus of Milo will be represented by an elaborate schedule of measurements, and Mona Lisa by a mathematical specification of the distribution of paint; still they are there, if only we can recognise them. I have here a history of the universe—or part of it. Unfortunately I was not able to draw it in four dimensions, and even three dimensions presented difficulties, so I have drawn the world-lines in two dimensions on the surface of a football bladder.

A great deal is shown here which, properly speaking, is not history at all, because it is necessarily outside experience. As we have seen, it is only coincidences—the intersections of the world-lines—that constitute observational knowledge; and, moreover, it is not the place of intersection, but the fact of intersection that we observe. I am afraid the two-dimensional model does not give a proper idea of this, because in two dimensions any two lines are almost bound to meet sooner or later; but in three dimensions, and still more in four dimensions, two lines can, and usually do, miss one another altogether, and the observation that they do meet is a genuine addition to knowledge.

When I squeeze the bladder the world-lines are bent about in different ways. But I have not altered the history of the universe, because no intersection is created or destroyed, and so no observable event is altered. The deformed bladder is just as true a history of Nature as the undeformed bladder. The bladder represents Minkowski's space-time world, in which the world-lines were drawn; so we can squeeze Minkowski's world in any way without altering the course of events. We do not usually use the common word "squeeze"; we call it a *mathematical transformation*, but it means the same thing.

The laws of Nature in their most general form must describe correctly the behaviour of the world-lines in either the undistorted or the distorted model, because it is indifferent which we take as the true representation of the course of Nature. That is a very important principle; but, being almost a truism, it does not in itself help us to determine the laws of Nature without making some additional hypothesis. There is one law—the law of gravitation—which especially attracts our attention at this point, and we shall look into it more closely.

We know that one particle attracts another particle, and so influences the history of its motion. This evidently means that one world-line will deflect any other world-line in its neighbourhood. Apart from this influence, the world-line runs straight, bending neither to the right nor to the left, provided the bladder is in its undistorted state, *i.e.* provided we use Minkowski's original space-time. That is not so much a matter of observation as of definition. It defines what we are to regard as the undistorted state, though it is by observation that we learn that it is possible to find a space-time in which the world-lines run straight when undisturbed by gravitational or other forces. I must own that there is a certain logical difficulty in saying that a world-line runs straight when there are no others near it; because in that case there could be no intersections, and we could learn nothing about its course by observation. However, that is not a serious difficulty, though you may be reminded of the sage remark, "If there were no matter in the universe, the law of gravitation would fall to the ground."

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE *Times* announces that Senator Dennis has given 12,000*l.* to Dalhousie University for a chair of political science in memory of his son, Capt. Eric Dennis, who was killed at Vimy Ridge; and that Major E. A. de Rothschild, who died at Cairo from wounds on November 17, aged thirty-one, has left the sum of 5000*l.* to Harrow School for a scholarship, the conditions of which are to be approved by his brother Anthony.

THE Department of Agriculture and Technical Instruction for Ireland has issued its programme of summer courses of instruction for teachers to be held this year. The courses will, with the exception of the courses of instruction in rural science (including school gardening) for National School teachers, begin on July 2, and close on July 26. The courses in rural science (including school gardening) will begin on August 6, and close on August 30. Teachers who attend the courses regularly will be allowed a sum of 3*l.* 10*s.* towards their expenses while living at the centre, and third-class railway fare for one return journey from the railway station nearest their school or centre. Among the subjects in which courses have been arranged are the chemistry of engineering materials, technology for teachers, experimental science, domestic science, and rural science. The courses are open only to those who are above twenty years of age, and, except in certain cases, only to teachers who are engaged (*a*) by local committees of technical instruction, or (*b*) in schools receiving grants either directly from the Department or under the provisions of an approved local scheme of technical instruction.

THE annual report of University College, London, shows that whereas in normal times the total number of students, day and evening, amounts to about 2200, the number last session was 1240. This number included 121 members of H.M. Naval and Military Forces, for whom special courses were provided, and 159 who attended special vacation courses, so that the actual number of ordinary students was 960, of whom 547 were women. The report points out that, while the normal fee revenue amounts to between 29,000*l.* and 30,000*l.* a year, the fee revenue last year was only 14,000*l.* Economies of every kind have been introduced, and all expenditure possible has been deferred. It is anticipated that, unless further help from the Treasury is forthcoming, there will be a deficit at the end of the current session of nearly 9000*l.* on the college establishment account. While the ordinary activities of the college have been maintained, all available energies have been directed towards war purposes, of which the report gives some account. Among the important developments of the year may be noted the admission of women to the faculty of medical sciences, the reorganisation of the department of Italian, the institution of a department of Scandinavian studies, and a movement for the institution of a department of Dutch studies. The *pro patria* list includes about 2500 names of past and present members of the college who are taking an active part in one or other of the Services connected with the war. Of these no fewer than 195 have already fallen. The list of honours and distinctions gained in the war is a long one.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 21.—Sir J. J. Thomson, president, in the chair.—Lord **Rayleigh**: The scattering of light by spherical shells, and by complete spheres of periodic structure, when the refractivity is small. The problem of a small sphere of uniform optical quality has been treated in several papers. In general, the calculations can be carried to an arithmetical conclusion only when the circumference of the sphere does not exceed a few wave-lengths. But when the relative refractivity is small enough, this restriction can be dispensed with, and a general result formulated. In the present paper some former results are quoted, but the investigation is now by an improved method. It commences with the case of an infinitely thin spherical *shell* from which the result for the complete uniform sphere is derived by integration. Afterwards application is made to a complete sphere of which the structure is symmetrical, but periodically variable along the radius, a problem of interest in connection with the colours, changing with the angle, often met with in the organic world.—Sir Joseph **Larmor**: The nature of heat as directly deducible from the postulate of Carnot. The germinal idea which developed, in the mind of Sadi Carnot in 1824, into the dynamical theory of heat was that heat can give rise to motive power only in the process of carrying through its effort towards an equilibrium. A proof is now offered that Carnot's principle regarding heat-engines follows from this basic idea by itself alone, without requiring the introduction of any hypothesis as to the physical nature of heat. It then further follows, from applying the same Carnot formula both to direct and to reversed working, that a scale of measurement of heat can be assigned, *i.e.* an ideal calorimetric substance can be chosen, so that the heat which disappears shall be the equivalent of the motive power that is gained, and conversely—that is, it follows that heat must itself be a form of energy. But a limiting case of this general result requires separate statement from the physical point of view, viz. the ratio of equivalence between heat and work may be so small that practically the heat is conserved as if it were a substance, and then the work may be said to be done by its fall to a lower potential, strictly after the analogy of the fall of water to a lower level. Finally, a second absolute scale of measurement, that of the potential or temperature of heat, may be chosen which reduces the thermodynamic relations to the standard simple form. It is also remarked that the original Carnot idea involves immediately the complete foundation of chemical physics as applied to isothermal processes; for under isothermal conditions it asserts that the interchanges of heat that occur during physical or chemical transformations do not enter at all into the interchanges of motive power—that is, of isothermal available energy. But physical knowledge was not wide enough for a dozen years after 1824 to enable any general survey of the energies of Nature to be thought of; and when the principle of the conservation and interchanges of total available energies came into the light through the theoretical explorations of Faraday, J. R. Mayer, and Helmholtz, and especially the practical experimental work of Joule, founded mainly on the relations of energy to heat, the Carnot restriction to uniform temperature was tacitly involved, though not overtly expressed until later. As a chapter in scientific method, it seems desirable to bring into view even now, the full potentiality that was latent nearly a century ago in the single creative idea of Carnot.—J. J. **Guest**: Curved beams. Previous investigations upon the stresses produced in a curved beam by a bending moment have not resulted in solutions satisfying the necessary elastic relationships. The author first treats the case of a beam which is narrow in proportion to its depth, obtaining expressions for the displacements and principal stresses. The results are then thrown into forms suitable for calculation. For the case of a wider beam the author then shows that for the third principal stress to be zero, both the inner and outer surfaces of the beam section must curve in a definite manner, depending upon the value of Poisson's ratio for the material used. The rigorous solution for the case of a very wide beam compelled by restraints to preserve a cylindrical form as it bends is then given. The paper concludes with a semi-graphical method for estimating the maximum stress occurring in other cases, that of a beam of circular section being worked out for different values of the curvature.—Dr. A. E. H. **Tutton**: Monoclinic double selenates of the iron group. In this memoir are described the results of a complete investigation of the crystals of the potassium, rubidium, cæsium, and ammonium salts of the iron group of double selenates of the series $R_2M\left(\begin{smallmatrix}S\\Se\end{smallmatrix}O_4\right)_2,6H_2O$. The outstanding result is to confirm the conclusions drawn from the previous study of three other groups of double selenates, and of eight groups (the complete set) of double sulphates. The general law of progression of the crystallographic properties, with the atomic weight and atomic number of the interchangeable alkali metals which form the group, is obeyed absolutely rigidly by the iron group.—Dr. A. E. H. **Tutton**: Selenic acid and iron. Reduction of selenic acid by nascent hydrogen and hydrogen sulphide. Preparation of ferrous selenate and double selenates of iron group. Some new properties of selenic acid have been observed. Instead of dissolving iron with evolution of hydrogen like sulphuric acid, selenic acid is without appreciable action on iron. After a very long time the latter becomes thinly coated with red selenium due to reduction of a trace of the acid by nascent hydrogen produced in the slight action which occurs. After attempts spreading over eight years the author has at last obtained $K_2Fe(SeO_4)_2,6H_2O$ crystals during four of the very cold nights of January, 1918, when the laboratory temperature fell to nearly 0° C. and never rose above 2° C. Above this temperature the salt is unstable. The crystals were pale green, well formed, and clear, but lasted at most only five hours after removal from the mother liquor, becoming opaque white, like porcelain.

PARIS.

Academy of Sciences, January 28.—M. Léon Guignard in the chair.—The president read the decree authorising the creation of a new division of six members under the title "Application de la Science à l'Industrie."—A. **Blondel**: The experimental determination and applications of the vector representing the effects of the direct armature reaction and leakages in alternators.—M. de **Sparre**: The hammering in a pipe with wall of variable thickness, in the case of a progressive closing.—A. **Buhl**: Certain Abelian sums of double integrals.—S. **Lattès**: The repetition of rational substitutions with two variables.—G. **Julia**: Problems concerning the repetition of rational functions.—F. **Iversen**: The asymptotic values of meromorphic functions and the transcendant singularities of their inverse functions.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the third quarter of 1917. Observations were made on ninety days, eighty of which, June 1 to August 19, were consecutive.—A. **Valeur** and E. **Luce**: The action of methylene iodide upon 1:4-dimethylaminopentene. A closed ring is not formed, as with iodine, but the addition of methylene iodide to nitrogen takes place, as with methyl iodide.—F. **Grandjean**: The step-like structure in certain anisotropic liquids.—P. **Russo**: Some peculiarities of the granitoid rocks of the Rehamna district (western Morocco).—R. **Chudeau**: The tectonic of western Africa.—G. **Lecointre**: The presence of the Cambrian and (possibly) Silurian at Casablanca (western Morocco).—Ch. **Dufour**: Value of the magnetic elements at the Val-Joyeux Observatory on January 1, 1918.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint-Genis-Laval) during the third quarter of 1917.—C. E. **Brazier**: The diurnal variation of the velocity of the wind in altitude.—M. and Mme. F. **Moreau**: Cytological study of the development of the apothecium of the Peltigeraceæ.—A. **Lécaillon**: Some cytological data relative to the phenomena of natural parthenogenesis which occur in the silkworm.—A. **Sartory**: The tubercle bacillus associated with an Oospora. The Oospora was isolated from a sputum also containing typical tubercle bacilli. The two micro-organisms possess certain characters in common, but the Oospora proved to be non-pathogenic to the guinea-pig and rabbit.—F. G. V. **Miranda**: Biochemical researches on *Proteus vulgaris*. Comparison of the properties of a pathogenic strain and a saprophytic strain. The experimental work cited confirms Metchnikoff's view that the pathogenic and saprophytic forms of Proteus are identical; the small differences between the various strains result from the influence, more or less prolonged, of the culture conditions.—A. **Berthelot**: Ptomaines and war wounds.—MM. **Rousseaux** and **Sirot**: The soluble nitrogenous materials as an index of the baking value of flour.

MELBOURNE.

Royal Society of Victoria, December 13, 1917.—Prof. W. A. Osborne, president, in the chair.—Prof. W. A. **Osborne**: A contribution to the theory of gel structure. Investigations carried out in 1910 showed that bubbles formed in gels assumed lenticular forms, but without any dominant angle. The Struve-Baumstark phenomenon—*i.e.* the expression of the liquid phase on treatment with ether—points to the fact that in certain gels the liquid phase is held by capillarity.—A. J. **Ewart**: (1) Contributions to the flora of Australia, No. 26. Amongst the plants enumerated is a newly introduced St. John's wort, found in the Government House grounds, whilst the spread of *Erica arborea* as a naturalised alien is also noted. Interesting data are furnished regarding the depth at which sweet briar and furze can reproduce their shoots. (2) Chlorophyll, xanthophyll, and carotin, and the production of sugar from formaldehyde. A new and rapid method was described of producing sugar from formaldehyde, in which the products were glucose, lævulose, calcium, and sodium tartrates.—J. T. **Jutson**: (1) The influence of salt on rock-weathering in subarid Western Australia. It is suggested that the salt from the dry pans, during periods of moisture, impregnate the rock around the lake, causing marked disintegration, which sometimes produces cavernous structure in the rocks of the lake margin. (2) The formation of natural quarries in subarid Western Australia. Illustrations are given of circular, triangular, and vertically faced quarries due to the varying hardness and nature of the weathered rock.

WASHINGTON, D.C.

National Academy of Sciences, November, 1917 (Proceedings, vol. iii., No. 11).—G. A. **Bliss**: A necessary and sufficient condition for the existence of a Stieltjes integral.—L. P. **Eisenhart**: Transformations of applicable conjugate nets of curves on surfaces.—C. A. **Fischer**: Bilinear and N-linear functionals.—C. L. **Burdick** and J. H. **Ellis**: The crystal structure of chalcopyrite determined by X-rays. Chalcopyrite belongs to the tetragonal system of crystals, few of which have been examined for structure. The lattice is of the face-centred type.—W. M. **Davis**: The isostatic subsidence of volcanic islands. Darwin's primary theory of coral reefs holds good, although his supplementary theory of broad ocean-floor subsidence needs modification.—O. **Veblen**: The deformation of an N-cell.—G. D. **Birkhoff**: A theorem on series of orthogonal functions with an application to Sturm-Liouville series.—R. A. **Daly**: Low-temperature formation of alkaline felspars in limestone. A review of recent European literature and a discussion of American Rocky Mountain dolomite.—C. **Barus**: The interferometry of small angles, etc. Methods by direct and reversed superposed spectra.

December, 1917 (vol. iii., No. 12).—C. W. **Metz** and C. B. **Bridges**: Incompatibility of mutant races in Drosophila. The evidence from two cases of incompatibility in laboratory cultures, taken with evidence from apparently mutant forms and incompatible varieties of Nature, tends to remove a serious objection to the mutation hypothesis, and emphasises the possible evolutionary importance of mutations involving incompatibility.—H. D. **Curtis**: Absorption effects in the spiral nebulæ. Negatives of spiral nebulæ obtained with the Crossley reflector show that the phenomenon of dark lanes caused by occulting or absorbing matter is much more frequent than has been supposed. The results may bear directly on the explanation of the peculiar grouping of the spirals.—O. L. **Raber**: The synergetic action of electrolytes. Synergy is the opposite of antagonism; although antagonism is frequently reported, few cases of synergy have been noted.—W. **Craig**: Appetites and aversions as constituents of instincts. Although innate chain reflexes constitute a considerable part of the equipment of doves, few or none of their instincts are mere chain reflexes. On the contrary, each instinct involves an element of appetite or of aversion, or both.—A. R. C. **Haas**: Rapid respiration after death. The respiration of Laminaria may be much greater after death than in the normal condition.—Caroline E. **Stringer**: The means of locomotion in Planarians. The locomotion is essentially a muscular act in which the cilia play no necessary part.—J. F. **McClendon**: Diurnal changes in the sea at Tortugas, Florida.—C. **Barus**: Note on interferometer methods of measuring the elastics of small bodies.—W. M. **Davis**: Sublacustrine Glacial erosion in Montana. The Clark fork branch-glacier seems to have done its visible erosive work on the valley-side spurs

—and presumably a considerable amount of invisible work on the valley bottom—although it must have been wholly submerged in Lake Missoula for two or three score, if not for four score, miles.—J. F. **McClendon**: The effect of stretching on the rate of conduction in the neuro-muscular network in Cassiopeia. Apparently stretching the nerve does not change the rate.—B. M. **Davis**: A criticism of the evidence for the mutation theory of De Vries from the behaviour of species of Œnothera in crosses and in selfed lines. Although most of the genetical work on Œnotheras has not been interpreted by the Mendelian system of notation, there is clear evidence of order in the results in inbreeding and crossing; the difficulty has been to discover and to isolate simple material in the confusion of mixed and impure forms of these plants.—W. D. **Harkins** and L. **Aronberg**: The spectra of isotopes and the vibration of electrons in the atom. The spectra of isotopes have been previously reported as identical within the errors of measure. The authors find, however, a slight difference. The wave-length of uranio-lead was very slightly longer than that of the ordinary lead.—J. F. **McClendon**: The effect of oxygen tension on the metabolism of Cassiopeia.

BOOKS RECEIVED.

Cambridge Papers. By W. W. Rouse Ball. Pp. vi+326. (London: Macmillan and Co., Ltd.) 6*s*. net.

Infinitesimal Calculus. By Prof. F. S. Carey. Section I. Pp. xiii+144+v. (London: Longmans and Co.) 6*s*. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College for the Years 1908–17. Edited by R. M. Milne. (London: Macmillan and Co., Ltd.) 7*s*.

The Science of Power. By B. Kidd. Pp. 306. (London: Methuen and Co., Ltd.) 6*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 7.

ROYAL SOCIETY, at 4.30.—Numerical Solution of Integral Equations: Prof. E. T. Whittaker.—(1) Cesaro Convergence of Restricted Fourier Series; (2) Non-Harmonic Trigonometrical Series: Prof. W. H. Young.—The Electro-magnetic Inertia of the Lorentz Electron: Prof. G. A. Schott.—Researches on Growth and Movement in Plants by Means of the High Magnification Crescograph: Sir J. C. Bose.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—The Control of Large Amounts of Power: E. B. Wedmore.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Application of Charcoal to the Precipitation of Gold from its Solution in Cyanide: H. R. Edmands.—Blast-furnace Smelting of Stibnite, with considerations on the Metallurgy of Antimony: W. R. Schoeller.—A "Responsive" Shaft Signal Device: B. Angwin.

LINNEAN SOCIETY, at 5.—(1) The Mimetic and Mendelian Relationships of the "White Admirals" of North America (with Lantern Slides). (2) A New Mimetic Form of *Pseudacraea poggei* (Dewitz) from ex-German East Africa, with other African Mimics of *Danaida chrysippus* (Linn.): Prof. E. B. Poulton.—Mimetic Species of the African Nymphaline Genus Pseudacræa and Lycænid Genus Mimacræa, together with their Acræine and Danaidine Models and Some of their Co-mimics: Lord Rothschild.

CHEMICAL SOCIETY, at 8.—Atomic and Molecular Numbers: H. S. Allen.—The Subbromide and Subchloride of Lead: H. G. Denham.—Studies on the Phenylsuccinic Acid Series. VI., Racemisation Phenomena observed during the Investigation of the Optically Active Phenyl- and Diphenylsuccinic Acids and their Derivatives: H. Wren.—The Alkaloids of Ipecacuanha. III.: F. L. Pyman.—The Constitution of the Disaccharides. II., Lactose and Melibiose: W. N. Haworth and G. C. Leitch.

FRIDAY, MARCH 8.

ROYAL INSTITUTION, at 5.30.—Vibrations: Mechanical, Musical, and Electrical: Prof. E. H. Barton.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Double Stars measured at the Cape Observatory: J. Voûte.—Planetary Motion in Space—Time of any Constant Curvature, according to the generalised Principle of Relativity: L. Silberstein.—The number of Stars of different Magnitudes in the Hyderabad Astrographic Catalogue. II., Zone −18°: R. J. Pocock.—Micrometrical Measures of Thirty-one new Double Stars: F. C. Leonard.—Errata in Van Biesbroeck's Third Series of Measures of Double Stars: E. Doolittle.—Solar Prominences, 1817: G. J. Newbegin.—The Early History of the Solar System: H. Jeffreys.—*Probable Papers*: The Measurement of Time to the Thousandth of a Second: R. A. Sampson.—The Secular Acceleration of the Sun as determined from Hipparchus's Equinox Observations, with a note on Ptolemy's False Equinox: J. K. Fotheringham.

PHYSICAL SOCIETY, at 5.—The Asymmetrical Distribution of Corpuscular Radiation Produced by X-rays: E. A. Owen.—On "Air Standard" Internal-Combustion Engine Cycles and their Efficiencies: Prof. C. H. Lees.

SATURDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

MONDAY, MARCH 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—My Second Year's Journey in Kansu: Reginald Farrer.

SOCIETY OF ENGINEERS, at 5.30.—Concrete Mixtures for Ferro-concrete Work: T. J. Gueritte.

TUESDAY, MARCH 12.

ROYAL INSTITUTION, at 3.—The Stifling of Children's Health: Dr. Leonard Hill.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Kinematograph Films Illustrating Water-power Works in Canada: Prof. J. C. McLennan.

ROYAL ANTHROPOLOGICAL INSTITUTE AND PREHISTORIC SOCIETY OF EAST ANGLIA (Joint Meetings).—The Prehistoric Society of East Anglia, at 3.—Presidential Address: Our Neighbours of the Neolithic Period: R. A. Smith.—Royal Anthropological Institute, at 5.15.—The Age of Some Megalithic Structures in the Mediterranean Area: H. J. E. Peake.

WEDNESDAY, MARCH 13.

ROYAL SOCIETY OF ARTS, at 4.30.—Ypres and other Flemish Cities Before and Since the War (in English): Paul Lambotte.

INSTITUTE OF METALS, at 8.—Presidential Address.

BRITISH ASSOCIATION GEOPHYSICAL DISCUSSIONS (Royal Astronomical Society), at 5.—Auroræ and the Electrical State of the Upper Atmosphere: Dr. C. Chree, Prof. A. Fowler, the Hon. R. J. Strutt, and Others.

THURSDAY, MARCH 14.

ROYAL SOCIETY OF ARTS, at 4.30.—English Commerce with India, 1608–1658: William Foster.

INSTITUTE OF METALS, at 4.—The Relationship between Hardness and Constitution in the Copper-rich Aluminium-Copper Alloys: J. Neill Greenwood.—Aluminium-Bronze Die Casting: H. Whittaker and H. Rix.—On Grain Size: Dr. G. H. Gulliver.—Lead-Tin-Antimony Alloys: Owen W. Ellis.—An Investigation on Unsound Castings of Admiralty Bronze (88:10:2): Cause and Remedy: Prof. H. C. H. Carpenter and Miss C. F. Elam.

OPTICAL SOCIETY (Imperial College of Science and Technology), at 8.—The Detection of Ghosts in Prisms: T. Smith.

FRIDAY, MARCH 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

SATURDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, MARCH 14, 1918.

REFRACTORY MATERIALS.

Refractory Materials: their Manufacture and Uses. By Alfred B. Searle. Pp. xii + 444. (London: Charles Griffin and Co., Ltd., 1917.) Price 15*s.* net.

IT is a pleasure to have the opportunity of acknowledging that the prime importance of refractory materials to our industries is at last receiving recognition. An attempt was made in 1909 (*vide Times,* January 21, and NATURE, January 28, of that year) to direct serious attention to this subject, but it was temporarily abandoned because of the failure of the majority to realise the urgency of industrial requirements. To-day we are on the border-line of danger at the other extreme. Contrasted with the apathy which prevailed a short time ago, the present attitude appears to some to border on hysteria. Schemes are being seriously entertained which, if not carefully handled, will lead to the Germanising of research in a bad sense, because certain suggestions which have been made seem based on the idea that the subject merely demands mechanical and routine observations on contractions, porosities, hardness, etc., and some suggestions, if adopted, would tend to suppress individuality. Mere interest in the problem *plus* a university degree are not a sufficient admission certificate to the adytum of clay-working. The neophyte requires initiation into the fundamental mysteries, so to speak, before he can wisely break the bond of silence.

The author of the present work has been a prolific writer on subjects more or less connected with clay-working. Although he has made no important original contribution to the art, his book is a very useful compilation, since it is convenient to have various fragments scattered in the technical journals collected into one volume. The serious student, however, may be dissatisfied with the inadequacy of the references to original sources, which are seldom given in sufficient detail, and in any future edition this blemish should be rectified. This is the more necessary because in some cases the originals have been so mutilated in transcribing as to convey erroneous impressions. An example occurs in the reference to the formulæ of the chief alumino-silicic acids, on pp. 4 and 9, where the essential point has been missed. In connection with the action of alkalis on clays (p. 5), it would have been better to give some indication of the large amount of work already published on the same subject, instead of waiting until the author of the book is able to fulfil his promise. The remarks on the actual composition of clays on pp. 4 and 5 are quite in accord with the general experience that clays are mixtures of various minerals, but there is something wrong on p. 7 when analyses of nine commercial clays are represented by complex graphic formulæ.

The statement on p. 41 that, "generally speaking, the compounds of silica are fusible, *with the one exception* [the italics are the author's] of the alumino-silicic acids (true-clays)," needs modifying, as it seems to imply that minerals like talc, olivine, leucite, topaz, zircon, sillimanite, and nontronite are fusible or are alumino-silicic acids.

On p. 42 we are informed that "the softening effect of mica is seldom noticeable below 1200° C., and that of felspar below 1300° C.," whereas on the previous page it is stated that "mica is a far weaker flux than felspar." Misprints are unfortunately rather numerous, though they do not always involve serious inaccuracies. A mild case occurs on p. 55, where *titanite* is represented as $CaTiO_5$.

The author apparently makes no distinction between yttria and ytterbia, for on p. 122 we find "yttrium oxide or ytterbia," and the latter name is again used instead of yttria twice on the next page. Another statement to which strong exception may be taken appears on p. 179, respecting "particles of iron sulphide (pyrite), which never give a red colour to the [fired] clay, but invariably show up as black or slagged spots." It would be interesting to know the authority for this. The proportion of grog to clay (1 to 8), as given on p. 284, for making saggers in Great Britain is far from being correct according to the practice of potters generally, if, indeed, for any British potters.

The results obtained by Wernicke referred to on pp. 96–97 doubtless justified the conclusions deduced by him and Wildschrey so far as the quartzites examined were concerned. But it would not have been out of place to add that some, at any rate, of the quartzites in the United States do not conform with these conclusions; for McDowell has expressly stated that the best American quartzites used for the manufacture of silica bricks show under microscopical examination no cementing ground mass, but consist solely of interlocking quartz crystals. This might be borne in mind in connection with the list of desiderata in quartzites for silica bricks, as set out on p. 98. The statement (on p. 96) that "it is essential to use a quartzite composed largely of tridymite" needs justification. Where can such quartzites be obtained?

One of the best features of the book is the description of processes with which the author is familiar; where he is on strange ground, serious mistakes have been made. For example, the attempt to cast glass pots by the method described on p. 341 could scarcely give a satisfactory result.

As previously intimated, the work possesses considerable value, notwithstanding such defects as those mentioned. The chapters deal with an exceptionally wide range of products and the corresponding raw materials, including the manufacture of firebricks from clay, silica, basic materials, bauxite, carbon, chromite, saggers, muffles, crucibles, glass pots, retorts, as well as fused silica ware, refractory porcelain, refractory mortars, and cements. The concluding chapter discusses the selection and application of refractory materials, and an appendix gives various standard specifications. The general index facilitates quick reference.

J. A. A.

A SURVEY OF AMERICAN ETHNOLOGY.

The American Indian: An Introduction to the Anthropology of the New World. By Clark Wissler. Pp. xiii+435. (New York: Douglas C. McMurtrie, 1917.) Price 3 dollars.

IN this synthesis of American ethnology Mr. Clark Wissler has given us a book which we have long needed. An immense amount of work has been done in American ethnology, but the results are scattered in ponderous tomes and in innumerable papers in various journals published in diverse countries, and hitherto no scholar had attempted the systematisation of all these data, which manifestly required much patient labour. In terse, direct language the author has brought together the essential facts, and thereby enabled students to gain a clear idea of the technique and distribution of industries, the main features of sociological and religious systems, and the demarcation of the larger groupings. References are given for most of the statements, numerous plates and figures illustrate the text, and there are a number of most useful maps showing various distributions. The scope of the book can be best gauged by giving an epitome of the contents: Food areas (gathering, hunting, agriculture, etc.), textile and ceramic arts, decorative art, architecture, social groupings and regulation, and ritualistic observances. A consideration of these forms the basis for a classification of social groups according to their cultures. North and South America are divided into fifteen culture areas conformable to principles previously enunciated by the author, central spots being selected and the marginal variations noted. Then follow archæological, linguistic, and somatic classifications, and finally a correlation of classifications and a discussion of culture origins and of New World origins.

A few remarks may be made concerning Mr. Wissler's position with regard to the broader problems of American ethnology. In common with the great majority of his American colleagues, he believes in the unity of the New World culture. "Notwithstanding the great diversity we have found, there are, on every hand, the unmistakable signs of unity. The higher cultures of Mexico and Peru are, after all, merely the great centres where the fundamental elements in New World culture were full blown." He is also impressed by the "many indications of somatic homogeneity strongly suggesting unity of origin." Surely no morphologist would regard the Lagao Santa type (to which no reference is made) as belonging to the same race as the Bororo, or many other tribes. Following the line adopted by Boas, he suggests that "the longer-headed Algonkins and Patagonians are merely the result of greater marginal isolation rather than survivors of a previous long-headed population."

Research becomes paralysed if all irregularities are to be dismissed as fluctuations from a common mean. Probably no one will disagree with the statement that "no necessary relation exists between the known types of culture, linguistics, and somatology." The analysis of each of these must proceed on independent lines, and it must always be remembered that cultures and languages can be adopted or discarded. The diversity of linguistic stocks in America is an unexplained puzzle for those who maintain the essential unity of the American Indians. Certainly as regards somatology there is very good reason to believe in several distinct migrations of different racial elements from north-east Asia. What cultures they severally brought with them is another matter.

In referring to certain cultural traits mentioned by Rowland B. Dixon as common to America and the Pacific, Mr. Wissler says: "There is no great *a priori* improbability that some of these traits did reach the New World from the Pacific Islands. Satisfactory proof of such may yet be attained, but such discoveries would not account for New World culture as a whole. Then there are abundant data to show that the Polynesians are recent arrivals in the Pacific; in fact, Maya culture must have been in its dotage long before they were within striking distance of the American coast."

We have not yet heard the last word on the problems of the diffusion of culture which are now exercising the minds of many ethnologists; to these this most excellent book will serve at once as a stimulus and a challenge.

A. C. HADDON.

RADIOGRAPHY.

Radiography and Radio-therapeutics. By Dr. R. Knox. Part i., *Radiography.* Second edition. Pp. xxv+382+xx+plates lxxviii. (London: A. and C. Black, Ltd., 1917.) Price 30*s.* net.

NOTHING better illustrates the advance in medical radiology and the stimulus given thereto by the war than the appearance of a second edition of this work. Upon its production in 1915 Dr. Knox's book became the standard British book on the subject of X-rays, as regards their application diagnostically or as a therapeutic agent. In view of the large amount of new information available it has been thought advisable to issue the second edition in two parts, and part i., "Radiography," has now been completed.

Generally speaking, the lines laid down in the original work have been followed, new matter supplementing the old in the appropriate sections. When an entirely new subject comes up for consideration, such as the detection of gas in the tissues, a new sub-heading is made in the chapter to which it is germane. This will greatly facilitate for the reader the transition from the original volume to the new issue.

The main additions to the work appear to be in the chapters (which, we notice, are not numbered) devoted to the electro-technique of the subject, the localisation of foreign bodies, stereoscopy, and diagnostic work upon the thorax and the alimentary system. In each of these sections there are considerable additions to the subject-matter of the first edition—present-day methods of dealing with war injuries receiving a good deal of attention by the author.

The illustrations, many of which are new, are very well reproduced, and reflect great credit upon the producers. We regret the omission of the bibliography; it is presumably intended to insert it in part ii., "Radio-therapeutics," but the size of the work warrants the division of the bibliography into two parts.

We notice that this book has been adopted by the U.S. Army and Navy Medical Departments. Whatever may be said as to the official recognition in this country of the significance of X-ray work, either on the diagnostic or the therapeutic side, and of the status of the medical radiologist, the appearance of this book leaves no doubt in one's mind that the study and practice of radiography are on a sound basis, an excellent foundation, in fact, for the structure of a British School of Radiology.

OUR BOOKSHELF.

The Gate of Remembrance: The Story of the Psychological Experiment which resulted in the Discovery of the Edgar Chapel at Glastonbury. By F. B. Bond. Pp. x+176. (Oxford: B. H. Blackwell, 1918.) Price 6s. net.

THIS little book furnishes an interesting record of a series of psychological investigations directed to elucidate certain hitherto unsolved questions in connection with the Glastonbury excavations. In 1907 Mr. F. B. Bond, in anticipation of his appointment to supervise the work, enlisted the aid of a friend, called "J. A.," both being members of the Psychical Research Society, and associated with the secretary in the inquiry. The object was to discover the site of the Edgar Chapel, which seems to have existed in the time of Queen Elizabeth, but which has now passed out of memory. Both the friends made a preliminary study of the monastic chronicles and other literature of the subject. They held numerous meetings, "J. A." grasping a pencil over a sheet of paper, and Mr. Bond resting his hand on that of his friend. By this method a number of scripts were recorded, some containing rudely drawn plans, purporting to be communications from one "Johannes Monachus," "Whyttinge, nuper Abbas," and others, who gave information by which, we are told, the position of the lost Edgar Chapel was determined.

It is obvious that Mr. Bond and "J. A." have compiled the record in perfect good faith, and they have pointed out errors of fact and style in the communications. They do not regard the communications as "the action of discarnate intelligences from the outside upon the physical or nervous organisation of the sitters." "J. A." is "disposed to concur with Mr. Bond in the view that the subconscious part of the mind may in its operation traverse the limitations of individual knowledge, either acting telepathically through contact with some larger field of memory, or as itself part of a larger unit of a more pervasive kind as regards time and space, conditions which would imply that the individual may have powers of self-expression far greater than those which are normally available through the brain-mechanism controlled by the will and logical faculties." This may be so, but others may prefer to attribute the manifestations to unconscious cerebration working on the authors' historical studies. Apart from its psychological interest, the excellent series of plans and sketches adds to the archæological value of the book.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1918. Edited by George E. Brown. Fifty-seventh issue. Pp. 660. (London: Henry Greenwood and Co., Ltd.) Price 1s. 6d. net.

THE general character of this annual is so well preserved that it needs an actual comparison with the pre-war issues to discover that it is reduced to about half its normal size. Although the "Epitome of Progress" for last year is somewhat curtailed, this is compensated for in great measure by condensing the abstracts and giving references. There has been so much talk with regard to rendering this country independent of foreign factories, so far as some of the more costly chemical preparations are concerned, that one naturally seeks for evidence of progress in this direction. It is satisfactory to note that the Ilford Company is now able to supply certain pure dyes prepared under the direction of Prof. W. J. Pope, of Cambridge University. It mentions a "considerable number" useful for the making of colour filters of all kinds, stains for microscopy, etc., and it is claimed that they are superior to the pre-war German products. Among the latest introductions are pinacyanol and pinaverdol, now called sensitol red and sensitol green respectively; sensitol violet, which is an entirely new panchromatic sensitiser; and filter yellow A. These, with metol and amidol (made by the firm of Johnson and Sons), and various metol substitutes, the compositions of which are not stated, show that a good deal has already been done. Perhaps the second most notable item is the rise in the price of photographic plates. Before the war the popular one shilling a dozen for quarter-plates was increased by 25 per cent., and now, by successive steps, the shilling has risen to two shillings and ninepence.

Memento Oppermann à l'Usage des Ingénieurs, Architectes, Agents Voyers, Conducteurs de Travaux, Mécaniciens, Industriels, Entrepreneurs. Pp. 268. (Paris et Liège: Ch. Béranger.) Price 6 fr.

THIS is a pocket-book for engineers, surveyors, and architects, and contains the information usually given in similar works published in this country. Only a few remarks are called for. The section on surveying includes a good description of the methods and instruments usually employed in the measurement of land, and gives specimen pages of field books. In the part dealing with weights and measures there are tables not only of the metric system, the use of which is now general throughout France, but also of various old French denominations, which, if not used at the present time in commerce or science, are at least often met with in legal documents. Particulars of the weights and measures of foreign countries are also given, and so far as regards the English system these are generally accurate. The compiler is not, however, aware that the metric carat of 200 mg. is the only legal unit of weight in this country for diamonds and precious stones, as he gives the equivalent of the obsolete English carat on p. 41. The troy weights mentioned on p. 44 are not, as there stated, used in this country by chemists; we have a special apothecaries' weight. On the whole, the work bears evidence of careful compilation, and is likely to prove useful to the professional men to whom it particularly appeals.

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.]*

Patents and Scientific Research.

IN connection with the excellent article on "Patents and Scientific Research" in NATURE of February 21, may I direct the attention of your readers to another article on the same subject published in *Science Progress* of January, 1914? Both articles must be read if any attempt is to be made to fit the patent system on to scientific research.

In my opinion, however, much the best way to encourage high intellectual effort of all kinds would be to establish a national pension fund for men whose work in any line has been of benefit to large numbers of the public without being remunerative to themselves, or, as sometimes happens, while being of actual pecuniary disadvantage to themselves. I have suggested this idea over and over again, but regret that I cannot get anyone to pay attention to it. For Britain, the present Civil List Pensions should be converted into such a pension scheme as I suggest. The pensions, which I anticipate would scarcely amount to more than 20,000*l*. a year altogether for Britain, ought to be allotted by a standing committee with a paid office—somewhat in the manner of the Nobel prizes. Of course, decision on rival merits of possible candidates may often be difficult, but the same difficulties now present themselves to all learned societies in allotting medals and other honours, and also to the Premier in allotting Civil List Pensions.

Yet another method is to admit the precedent of Jenner, who received 30,000*l*. on petitioning Parliament. I tried this method, as a test of the intelligence of the country, before the war (see *Science Progress*, October, 1915); but the present Premier, when he was Chancellor of the Exchequer, refused to allow my petition to go forward, although my lawyers assured me that it was a perfectly valid one.

At present the British nation is paying large sums of money to supply junior scientific workers with laboratory facilities and small salaries for doing pot-boiler scientific work in the hope of possibly making some discovery in the future, while it gives nothing whatever to those who have already done work of established and even universal value. I wonder why our countrymen find it so difficult to understand such simple ideas.

RONALD ROSS,
Editor of *Science Progress*.

36 Harley House, London, N.W.1, March 4.

Whale-meat in War Time.

AN announcement in the daily Press states that whale-meat furnished the principal article of food at a luncheon given in New York by the American Museum of Natural History to demonstrate the possibilities of whale-meat for home consumption, in order that the beef thus saved might be sent by America to relieve the scarcity prevailing among the Allies in Europe.

All who were privileged to partake of this luncheon must have gone away satisfied that the substitution of this meat for beef and mutton would entail no hardship, but, on the contrary, would prove a welcome addition to the bill of fare. This at any rate is the conclusion arrived at by members of the staff of the British Museum of Natural History, who have recently experimented with the flesh of a white-beaked dolphin stranded on the Suffolk coast.

Unfortunately, we can do little to assist in this saving, for the whales in our home-waters cannot be "fished," since neither ships nor men are available for the purpose. Similarly, lack of tonnage prevents importation from the Antarctic waters and elsewhere under cold storage.

It is to be hoped, however, that the fullest possible use will be made of the carcasses of the various species of Cetacea stranded around our coasts. Of course, no great quantity of meat would thus be obtained, but locally it should form a very welcome addition to the scanty meat rations now of necessity prevailing.

Whale-meat has no fat, but is encased in a thick layer of "blubber," which, when boiled down with water, yields a large quantity of clear, amber-coloured oil, just now very precious. It has, however, a slight and rather unpleasant odour, but it should not be difficult to eliminate this.

The dark red colour of whale-meat is likely to arouse prejudice against it. But if those who have opportunity will only make trial of its qualities as a food, they will find it scarcely distinguishable from beef, and quite as palatable. Such experiments may well create a demand for this meat after the war. This should lead to a revival of the now extinct Dundee whaling industry, remodelled after the methods followed by the Norwegians, in whose hands modern whaling now almost entirely rests. The difficulty of finding suitable gunners could easily be overcome by employing men trained in the Navy. Many new industries will arise among us after the war. This may well be among the number. It is ridiculous to suppose that we are unable to master the requirements of modern whaling; but, as matters now stand, British whaling companies have to depend for their principal officers on Norwegians. There is no reason why this state of things should continue.

W. P. PYCRAFT.

THE LEGEND OF ALEXANDER AND HIS FLYING MACHINE.

BY the kind assistance of Prof. H. Fehr, of Geneva, and the help of M. Stuckelberg, professor of the history of art in the University of Bâle, we are able to give an additional photograph of the "Legend of Alexander," taken from the sculptured capital, in the choir of the cathedral of Bâle, on a Romanesque column of the twelfth century.

Guided by the previous photograph, given in NATURE of August 23 last, of the bas-relief on St. Mark's, Venice, we are able to identify the subject, in the words of "Love's Labour's Lost"—"My scutcheon plain declares that I am Alisander"—and make a comparison of the details in their close resemblance and attention to the description by the Pseudo-Callisthenes in his fabulous "Life of Alexander."

In the Bâle sculpture the throne of Alexander, placed on an ox-yoke, is seen reproduced more like a car-shaped boat, but the unbridled griffins (στομίων ἄτερ) are there. And Alexander holds the two sceptres—joy-sticks, in the language of the airman—baited with cakes instead of the rabbits shown at Venice, or the lumps of liver in the narrative of Pseudo-Callisthenes, where, we are told, the griffins were kept sharp-set for some time before a flight, in a manner known to the lion-tamer, and so followed the tasty bait of direction control whichever way it pointed.

The St. Mark's photograph has been reduced as a lantern slide by the kindness of the National Physical Laboratory. But when the slide was shown enlarged on the screen as the company was once assembling for a lecture to the Aeronautical Society, the members looked up on entrance, and looked away again without comment. Not one seemed to recognise it as the representation of a flying machine, the earliest known. It may be, then, that other versions of the legend are in existence in various cathedrals, but the meaning has been lost, and they are not recognised in relation to flight in the air.

So, too, it is possible that the capital at Bâle is regarded as representing some kind of progress over the water, or under it, from the boat-like shape of the car; and it was not recognised as intended to take to the air, because Pseudo-Callisthenes describes the machine as capable of being used as a submarine, as well as a flying machine; and this, too, is the account of Æthicus, quoted by Roger Bacon in "De Secretis Operibus Artis et Naturæ":—

Possunt etiam fieri instrumenta volandi, et homo sedens in medio instrumenti revolvens aliquod ingenium, per quod alæ artificialiter compositæ aerem verberent, ad modum avis volantis.

Possunt etiam fieri instrumenta ambulandi in mari et in fluviis ad fundum sine periculo corporali. Nam Alexander magnus his usus est, ut secreta maris videret, secundum quod Ethicus narrat astronomus.

Roman capital of the twelfth century in the choir of Bâle Cathedral.

Hæc autem facta sunt antiquitus, et nostris temporibus. Et certum est, præter instrumentum volandi quod non vidi, nec hominem qui vidisset cognovi, sed sapientem qui hoc artificium excogitavit explicite cognosco.

The romance of Callisthenes appears to have had a great vogue in the early and middle ages, and an allusion to it would be familiar to all; so an organised search should be undertaken in other cathedrals and churches of similar representations, not yet identified as on this one subject of flight, in stained glass and tessellated pavement, as well as sculpture and bas-relief.

The book used at school has the powerful influence in moulding the mind, and providing association of ideas familiar to all. A quotation from a school book is sure of acceptation and comprehension.

Horace, in his ode on Archytas, mentions the flying machine among his mechanical achievements, if we may interpret so his "aerias tentasse domos—Tithonusque remotus in auras." But he mixes up Archytas and Archimedes in "numeroque carentis arenæ mensorem," both authors being in use in his schooldays for mathematical and cosmographical instruction. The curtain goes up on Antony and Cleopatra engaged in an amatory disputation on the Psammites Arenarius of Archimedes.

And here we, too, are quoting ourselves from the ode of Horace as familiar to all from schoolboy days.

Interpretations of this ode are various, but we may imagine Horace has arrived at the last stage on the Appian Way to the terminus at Brindisi, and employs the waiting time to visit the sights of Tarentum, where he comes across the tumulus of Archytas—"that old beast," he would call him in schoolboy terms, as the author of the text-book of arithmetic, geometry, harmonics, spherics. The epitaph then tells him the tomb is a cenotaph, and the real site of burial is away far to the north on the other sea, in a small memorial.

Another school author was Aratus, for instruction in astronomy, and so could be drawn on as familiar to all. Ovid is full of allusions from Aratus, and Cicero contemplated a translation into Latin verse. Aratus is quoted also by St. Paul as familiar to his audience, as Newton reminds us in the "Principia."

The mathematical fragments of Archytas, collected in "Mélanges Graux" (Paris, 1884), will trace his influence on the young minds of the Latin poets, Virgil, Ovid, Horace. They give the history of the problem of the two mean proportionals, generalisation of the Delian problem of the duplication of the cube, and incidental to angle trisection, among famous problems of antiquity, such as squaring the circle. And in his "Harmonics" Archytas was the first to direct attention to the harmonic progression shown in the divisions on the musical chord where it must be touched to give the successive overtone notes of frequency 1, 2, 3, etc. But the graphical and mechanical methods of Archytas drew down the scorn of Plato, pioneer of Rigour, as contaminating the purity of Geometry with material contact.

And what would Plato have said—originator of the sentiment, "Here's to Mathematics, and may they never be of use to anybody"—if he had foreseen the latest development of the harmless flying toy of Archytas, described with such prescience by the artist-mechanic in "Rasselas" (1759)?

If men were all virtuous, I should with great alacrity teach them to fly. But what would be the security of the good, if the bad could at pleasure invade them from the sky? Against an army sailing through the clouds, neither walls, mountains, nor seas could afford security. A flight of northern savages might hover in the wind, and rush with irresistible violence upon the capital of a neighbour region.

G. GREENHILL.

METEOROLOGY IN NORWAY.[1]

THE volume before us, published in celebration of the fifty years' existence of the Norwegian Meteorological Institute, commences with brief sketches of the lives of Prof. Henrik Mohn and Director Aksel Steen, to both of whom the institute, to a large extent, owes its development. A very interesting account is given of the history of meteorology in Norway. Owing to the peculiar geographical position of the country, meteorology was early found to be of special importance, and observations were taken from the end of the seventeenth century; but it was not until the beginning of the nineteenth century that regular observations in the modern sense of the word were commenced. In 1811 Prof. Esmarck began them in Christiania, and in 1837 Prof. Hansteen took daily observations of pressure, temperature, wind direction and force, cloud amount, and appearance of the sky. A scheme was then put on foot for organising daily observations in the different parts of the country, but these gradually fell off, until in 1850, with the exception of the unbroken records at Christiania, meteorological work in Norway was almost at a standstill.

It was the great storm of 1854, which overtook the French and English fleets on the Crimean coasts, that gave a new impetus to meteorology in Europe, and in 1855 Le Verrier made proposals for an international weather service. Norway was greatly interested in the new movement, and in 1860 C. Nielsen, Director of Telegraphs in Norway, established five stations along the coast—Christiansund, Aalesund, Skudenes, Mandal, and Sandøsund—with the necessary instruments and staff. At these stations observations were made three times daily of pressure, temperature, humidity, wind, weather, and cloud. A short time later an inland station was established at Dombaas, and reports were exchanged between these stations and Sweden, and also, after a few years, with Paris.

The six stations were soon found to be insufficient for the proper development of meteorological work in Norway, and in 1865 it was resolved to erect a meteorological institute and to appoint a professor of meteorology. The institute was commenced, and in 1865 Henrik Mohn was appointed professor of meteorology and director of the Meteorological Institute. New instruments were installed at the existing stations, and on December 1, 1866, the Norwegian Meteorological Institute began its operations, with the co-operation of the six stations mentioned, and also of Bergen and Christiania.

Prof. Mohn's initiative soon resulted in great developments: the number of climatological sta-

[1] Meteorologien i Norge i 50 aar. (Christiania: Grøndahl and Sons.)

tions was rapidly increased; in 1871 there were fifty-five, in 1898 eighty. The collection of rainfall statistics also interested Prof. Mohn greatly, and by 1890 he had established nearly 100 stations, in 1895 the number reached about 300, and a few years later 500 stations reported rainfall to the institute.

The international exchange of telegrams was also developed. As early as 1869 telegrams were received from Great Britain; Denmark commenced in 1871, Sweden in 1873; Russia, Finland, Germany, and France began in 1892, and the Faröe Islands in 1907; Spitsbergen, Austria-Hungary, and Italy joined in 1912, followed in 1913 by Holland, Spain, Portugal, and Madeira.

Meanwhile the telegraphic reporting of observations from Norwegian stations was increased; by 1892 thirty-three stations reported by telegraph, while by 1914 the number had increased to sixty-nine.

Services of storm-warnings and forecasts were commenced early in the history of the institute. The reports and publications were organised and developed, and the volume gives diagrammatic representations of the growth of the institute's reporting stations, staff, budget, and library.

Aerology received much attention at the beginning of the present century; sounding balloons were sent up, and in 1909 pilot-balloon ascents were begun. In 1912 this part of the work was taken over by Prof. V. Bjerknes, and it is now carried on by the observatory at Aas.

Notes are given on the past and present members of the staff of the institute, and detailed descriptions of the growth and work of each of the three sections dealing with climatology, forecasting, and rainfall respectively. The establishment and work of the observatories at Aas, Bergen, and Haldde are described, and the book is illustrated by interesting photographs of the institute and observatories, and by reproductions of charts and diagrams.

NOTES.

THE letters that have appeared recently in the *Times* and in articles elsewhere on the effect of electric action on the growth of plants show a readiness to believe that almost any wonders may be wrought by electricity. Most scientific workers will agree with Prof. Armstrong and Sir James Crichton-Browne in their scepticism as to the proved value of electrical treatment as a general method of increasing crop production. It is asserted that by the electrical treatment of seeds increases of yield of 20 to 80 per cent. may be produced. The statement seems to refer to a commercial process in which, apparently, seeds are subjected to the combined action of electric currents and certain solutions; in the method electrolysis appears to play some part. The process seems based on the treatment known to physicians as "ionic medication," and used, for example, for the reduction of swollen joints. Treatment of seeds in this way appears to have no sound physiological basis, and no data derived from experiments carried out under critical conditions appear to be available, so that it is impossible to evaluate the method. No one who knows the difficulty of carrying out satisfactory agricultural experiments, and the ease with which a few favourable but illusory results can be obtained, is likely to accept the views of a few farmers as convincing evidence of the value of the process. The method of treatment of the growing plant with a high-tension discharge from overhead wires has been before the public for some years; it is certainly more promising, but it is generally admitted to be in a purely experimental stage.

SIR J. J. DOBBIE, Government Chemist, and principal of the Government laboratories, has been elected a member of the Athenæum Club under the rule of the club which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

SUMMER-TIME began in France and Italy on March 10; it begins with us on March 24, and will begin in Holland on April 1. The dates on which summer-time ends are also different in different countries. However much "daylight saving" by alteration of clocks may be appreciated by the public, there can be no doubt that the varying dates adopted for the beginning and ending of the change of standard are most confusing, and will render it very difficult to determine the exact instant at which any records of observations of natural occurrences are made.

THE issue of the *Comptes rendus* of the Paris Academy of Sciences for January 28 contains a decree of the President of the Republic creating a new division under the title "Application de la Science à l'Industrie," which is to consist of six members, who are to enjoy the same privileges as the "Académiciens libres," without restriction as to residence. There is probably no more conservative scientific organisation in the world than the Académie des Sciences, and there could be no more significant sign of the changed conditions of the times than this action on the part of the French Government and the academy in thus seeking to bring science and industry into closer relationship.

IN connection with our note on the Air Force Medical Service in last week's issue, we may direct attention to the appointment of a Medical Administrative Committee. According to the *Lancet*, the Director-General of the Naval Medical Service is chairman. The other members are the Director-General of the Army Medical Service, Fleet-Surgeon R. C. Munday, Major C. B. Heald, Surgeon-General Rolleston, Dr. Henry Head, Mr. Raymond Johnson, Dr. Leonard Hill, and Sir Walter Fletcher. We observe with satisfaction that the scientific aspects of the problems will be likely to receive consideration. At the same time, the physiological representatives are small in number compared with the official and medical members, a fact to be regretted in view of the nature of the chief questions with which the Committee will have to deal. These questions require a wide knowledge of a great variety of physiological problems.

As the outcome of a conference held on November 7 last, at which there were present representatives of the Committee of the Privy Council for Scientific and Industrial Research and of the Department for the Development of Mineral Resources, besides many of the land- and mine-owners of Cornwall, a fund for research has been raised, and a Research Board has been appointed by the Committee of the Privy Council. The members of the Board are:—Sir Lionel Phillips, Bt. (chairman); Mr. J. G. Gilbert, Cornish Chamber of Mines; Sir Frank Heath, Department of Scientific and Industrial Research; Sir T. K. Rose, chairman of the Research Committee of the Board; Mr. Edgar Taylor, Institution of Mining and Metallurgy; Mr. R. Arthur Thomas, Cornish Chamber of Mines; and Sir Richard Threlfall, Advisory Council for Scientific and Industrial Research; with Mr. A. Richardson as secretary (15 Great George Street, Westminster, S.W.1). The Board, after consultation with its Research Committee, has authorised extended lines of research with the view of increasing the recovery of metal in the treatment of ores.

In his lecture on "Chemical Research in Relation to Industry" (Adelaide: G. Hassell and Son) Dr. Hargreaves says little that is new and nothing that is not true. The arguments he uses apply equally to us here and to our colleagues in the Antipodes. Dr. Hargreaves is Director of the Department of Chemistry of South Australia, which Department he describes as a connecting link between the industries and the pure man of science, and his lecture deals with two main topics: first, the need for closer co-operation between scientific men and business men; secondly, the need for paying chemists an adequate salary in order to get the right men. We are, in this country, face to face with the same two questions, and there is a grave risk that Great Britain as a whole will not realise their importance. There are indications that the scientific world here is now convinced on both these points, but the majority of business men keep aloof from science, and have been of late too busy with their own difficult problems to apply their minds to an investigation of matters outside their usual routine. Dr. Hargreaves's lecture is temperately written and contains some useful suggestions. It is to be hoped that a real effort will be made to interest the commercial men in this country in these problems of pressing and national importance, but present conditions make it difficult to start a crusade of the necessary dimensions.

Mr. W. J. Uglow Woolcock, the registrar and secretary of the Pharmaceutical Society, has been appointed secretary of the Association of British Chemical Manufacturers.

Mr. F. W. Hodge, head of the Bureau of American Ethnology of the Smithsonian Institution since 1905, has resigned, and has been succeeded by Dr. J. W. Fewkes, who has been on the Bureau's staff since 1895.

We notice with regret the announcement of the death of Prof. E. W. Davis, dean of the College of Arts and Sciences and head of the Department of Mathematics of the University of Nebraska, at the age of sixty years.

The death is announced, at the age of seventy-three years, at Dorchester, Mass., of Mr. Paul S. Yendell, known particularly by his studies of the light-curves and periods of variable stars of the Algol and short-period types.

We learn from *Science* that Prof. Rollin D. Salisbury, head of the Department of Geography and dean of the Ogden Graduate School of Science at the University of Chicago, has been awarded the Helen Culver gold medal of the Geographic Society of Chicago. Prof. Salisbury was the first president of the society twenty years ago.

The meeting of the Institution of Electrical Engineers on April 11 will be held at King's College, Strand, W.C.2, at 6 p.m., and will be a joint meeting with the electrical section of the Royal Society of Medicine. Papers will be read on the subject of "Medical Electricity," and there will be an exhibition of apparatus.

The Röntgen Society has recently founded an annual lecture in memory of its first president, the late Prof. Silvanus P. Thompson. The first "Silvanus Thompson Memorial Lecture" will be delivered by Sir Ernest Rutherford at the next meeting of the society, to be held on Tuesday, April 9, at 8 p.m. The council will be pleased to welcome all interested, and applications for cards of admission should be made to the hon. secretary of the society, Dr. S. Russ, Middlesex Hospital, London, W.1. Further particulars will be announced in due course.

The sudden death, on January 20 last, in his fifty-fifth year, of Dr. Rollin A. Harris, of the U.S. Coast and Geodetic Survey, is announced in *Science*. Dr. Harris entered the Tidal Division of the U.S. Coast and Geodetic Survey in 1890, and his "Manual of Tides" appeared in six parts between 1884 and 1907. In 1911 a monograph by him on "Arctic Tides" was published by the Survey. In addition, Dr. Harris was the author of numerous papers on the theory of functions with applications to physics, geodesy, and cartography.

We much regret to learn of the death of Dr. Lewis Moysey, who was lost by the torpedoing of the hospital ship *Glenart Castle* on February 26. Dr. Moysey had only just joined the ship as one of its medical officers, and he was not among the survivors. Dr. Moysey, previous to the war, had long been in practice as a medical man at Nottingham. He was a very keen palæontologist, greatly interested in the rarer fossils of the coalfield around his home, and to the collection of such specimens in the field he had for many years devoted the scanty leisure of a busy professional life. He thus acquired an exceptionally fine series both of plant and animal remains, some of which he described in a number of papers, especially before the British Association, and others he placed in the hands of friends who were specialists in these departments. Only a few weeks before his death he handed over as gifts his entire collections, the plant remains to the University of Cambridge, and the animal fossils to the Geological Survey. Dr. Moysey possessed great charm of manner, and his loss will be much deplored among those interested in the palæontology of the older rocks.

We regretfully record the death on February 6 of Capt. S. Gordon McDakin (retired), formerly of the Black Watch, but long resident in Dover, and there taking a leading interest in scientific affairs. During many years he presided over meetings of the Dover Sciences Society. His latest paper, on "Some Remarkable Mountains," was published in 1909 by the East Kent Scientific Society, which he also addressed on "Coast Erosion" and on "Fissure Flows of Lava." The former subject he brought before his home society, coupled with that of "Sea Temperature," and later on addressed it on the topic of "Shingle and Conglomerates in Reference to Local Deposits." That he was a trustworthy botanist is indicated by his papers on "Verification of Records of Flora" and "Verification of Botanical Records," the latter in partnership with the Rev. J. Taylor. At the initial constituent meeting of the South-Eastern Union of Scientific Societies in 1896 Capt. McDakin was one of the Dover delegates. His cheerful presence became welcome at every congress, generally in company with his wife, who encouraged him in his favourite pursuits. Science is apt sometimes to groan a little under its own weight of production. Capt. McDakin was therefore a useful type of man, content to inspire in his neighbours appreciation of scientific work, without appealing to the Press for any solid monument to himself.

An Entomological Society of Spain has lately been founded, with its centre for the present at St. Saviour's College, Saragossa. Dr. Hermenegildo Gorría, of

Barcelona, is the president for 1918, and the Rev. R. P. Longinos Navás, S.J., the secretary. The society will deal with insects and the other arthropods usually studied with them from every point of view, both purely scientific and economic. Except from July to September, it will hold a monthly meeting for the reading and discussion of papers, and each meeting will be followed by the issue of a small *Boletín*. We have just received the first part of this publication (Nos. 1 and 2, January, 1918), which contains the rules of the society, the first list of members, and a portrait of the president. Following this preliminary matter there is the first instalment of a catalogue of the Coleoptera of Spain, by the Rev. José María de la Fuente. We congratulate our Spanish colleagues on the marked increase of activity in the pursuit of natural science in their country during recent years, and add our best wishes for the success of the important new society.

A COPY of the annual report for the year 1917 of the Philosophical Institute of Canterbury, New Zealand, has been received. During the year the presidential address on some questions of efficiency was given by Mr. L. Birks, and the following lectures were delivered:—Prof. H. B. Kirk, "The Fly Nuisance and its Control"; Prof. J. Hight, "Science and Economics"; and Prof. W. P. Evans, "Some Poison Gases." In April, by request of the local Commissioner of the National Efficiency Board, members of the council of the institute waited on him and discussed matters relative to national efficiency. Another question which has engaged the attention of the council is the proposal made by the "Scientific and Industrial Research Committee" of the New Zealand Institute to recommend the establishment of a national "Board of Science and Industry." The council criticised some features of the scheme, and trusts that the proposal will materialise, and that an institution of great national value will result. The sum of 110*l*. allotted by the New Zealand Institute to members of the Philosophical Institute was received. Considerable progress has been made in the investigation of the phosphate rocks of Canterbury by Messrs. R. Speight and L. J. Wild. Certain preliminary work has been done on the other investigations, viz. "The Deterioration of Apples in Cold Storage" and "The Electrical Prevention of Frosting in Orchards."

"AT a certain stage of social evolution," says Sir James Frazer in his article entitled "The Killing of the Khazar Kings," in the December (1917) issue of *Folklore*, "not a few races appear to have been in the habit of putting their kings to death, either at the end of a fixed term, or on the failure of the king's health and strength, or simply whenever a great public calamity, such as drought or famine, had befallen the country." Among tribes which have practised this remarkable form of limited monarchy must now be included the Khazars, or Khozars. For some 900 years this now almost forgotten tribe, from their home in the spurs of the Caucasus and along the western shore of the Caspian—called after them the Sea of the Khazars—played a great part in history on the European-Asian borderland. It is certainly remarkable that a people which had reached such a high level of civilisation and culture should have practised legalised regicide. But the evidence collected by Sir James Frazer from a very wide survey of medieval literature leaves no doubt on the matter. This survey of an almost unknown tribe is a contribution to anthropology of permanent value.

IN the *American Museum Journal* for December last Mr. Roy C. Andrews gives an admirable summary of the results of his expedition to Yunnan on behalf of the American Museum of Natural History. Herein he gives a valuable account of the habits of the goral and serow, of which but very little is known. These animals are rare in museum collections, so that he is not unnaturally proud of the fact that he has secured for his museum thirty-two gorals of at least two species, and seven serows of three species, forming a series the like of which is to be found in no other museum in the world. A large series of a shrew-like animal, of the genus Hylomys, extremely rare in collections, constituted the most striking of the additions to the smaller mammals made by the expedition. A number of remarkably fine photographs add immensely to the value of this contribution.

THE insect pest known as *Icerya purchasi*, originally a native of Australia, according to a report reprinted in the *Pioneer Mail* for November 24 from the *Agricultural Journal of India*, has now acquired a firm footing in Ceylon. It is especially destructive to citrus trees, but it may be found on other trees and plants, including the pomegranate, grape, rose, castor, mulberry, apple, peach, apricot, fig, walnut, willow, pepper, and potato. The adult female is about one-fifth of an inch in length and rather less in breadth, and is of a brown, reddish, or blackish colour, the body being overlaid by a large, white-fluted, cottony mass, in which the eggs are laid. In view of the great damage done to orange-groves in the United States, the Government sent a man of science to Australia, and the result was that a number of small red and black ladybird beetles (*Novius cardinalis*) were carried to California, where they speedily multiplied and dealt effectively with the Icerya. The Government of India is now undertaking inquiries to prevent the entry of the pest into that country.

OF the great memoir on "Hawaiian and Other Pacific Echini," begun in 1907 by Alexander Agassiz and H. Lyman Clark, three parts were published by the joint authors, and, with a fourth part by Dr. Clark, composed vol. xxxiv. of the Memoirs of the Museum of Comparative Zoology. Two further parts by Dr. Clark have now completed the work (Memoirs, vol. xlvi., Nos. 1 and 2). Of these, the former deals with the suborder Clypeastrina, or shield-urchins, and the systematic descriptions are preceded by a general discussion. Dr. R. T. Jackson has given reasons for the belief that the clypeastroids were derived from a group of regular urchins of which the Arbaciidæ are modern representatives. Dr. Clark, however, points out that, in the perforation of their tubercles and the structure of their pedicellariæ, they more closely resemble the Saleniidæ. The final part of the memoir consists of 200 pages and eighteen plates devoted to that large assemblage of much-modified urchins known as Spatangina, or heart-urchins. This is believed to include forms derived from at least two, and possibly four, distinct stocks. Dr. Clark does not, however, attempt to represent this in his classification. There is a discussion of the various structures used in classification, such as pedicellariæ and fascioles, but as regards the latter Dr. Clark does not make use of the important study published by B. Hoffmann in the *Palaeontologische Zeitschrift*, 1914. The present memoir adds one more to the valuable and admirably produced zoological publications arising out of the cruises of the U.S. Fish Commission steamer *Albatross*, and Dr. Lyman Clark is to be thanked and congratulated on completing his important share of the work.

A REPORT on the work of the Imperial Institute for South Africa, presented to the Committee for the Union of South Africa and Rhodesia at its last meeting, includes an interesting reference to the possible utilisation of the waste bark of the wattle-tree, which is extensively cultivated in South and East Africa. The waste, from which the tanning constituent has been removed, can be utilised both here and in Natal, where tanning extract is at present being produced, for the manufacture of an excellent brown paper or millboard. The waste from tanyards in this country may thus be a source of remuneration, and in South Africa an important industry may be created where brown paper and millboard for packing purposes, especially for fresh fruit transport, are in great demand, and have to be imported for the purpose. The wood of the Acacia trees from which the bark has been taken can also be utilised for millboard. According to the report, arrangements are already being made for the use of spent wattle bark in this country by paper manufacturers.

A PAPER entitled "British Trade and the Metric System" was read by Mr. E. A. W. Phillips at a recent meeting of the Concrete Institute. Mr. Phillips proposes a system of weights and measures including, in addition to the more usual English denominations, a decimal scale based on a "British metre" of 39·6 in., the ton of 2240 lb., divided into ten sacks, or 1000 "British kilograms," and a cubic British metre of pure water divided into 1000 litres. It is mentioned that the proposed metre is the same length as the ancient Belgic yard, which the author calls the "Anglo-Saxon metre," and he states that this has existed in Britain since the third century at least. Five of these yards made the rod, pole, or perch used in land measure. Mr. Phillips raises the question of the possibility of making his proposed decimal system the international standard for trade, commerce, and engineering, and of restricting the metric system proper to purposes of pure science. As regards coinage, his proposals include the retention of the pound sterling of ten florins and the division of the florin into 100 imaginary cents of account, not coined, for use in decimal accounting and decimal quoting.

A RECENT Technologic Paper (No. 103) of the U.S. Bureau of Standards deals with some typical cases of selective corrosion of 60 : 40 brass, or Muntz metal. The specimens described by the author, Mr. H. S. Rawdon, include bolts, sheathing, and condenser tubes. In all the cases examined, the selective corrosion takes the form of a removal of zinc from the β crystals, the α constituent not being attacked until a later stage. The corroded mass retains its external form, but consists only of spongy copper. A sharply defined boundary between the corroded portion and unaltered brass is always present, without any intervening zone of lower zinc content. Chemical action advances in the first instance along the boundaries of the crystal grains, and in the β crystals also along systems of intersecting planes, which may be twinning planes. Contact with a more strongly electro-negative metal has an accelerating influence, but none of the actual cases observed can be attributed to this cause. Experiments with grooved bars under tensile stress show that local increase of stress favours corrosion. Annealing has little effect. The results on the whole confirm those obtained by previous workers, but the photomicrographs illustrate very clearly the successive stages in the removal of zinc from alloys of this class.

THERE has been such a vast increase in the manufacture of organic nitro-compounds for the production of both dyes and explosives since the outbreak of war that the vexed question of the estimation of nitrogen therein has probably become acute. To the Journal of the Society of Chemical Industry of August 31 last Mr. A. P. Sachs contributes an account of what seems to be a highly successful method of effecting this estimation. The method depending on the reduction of the nitro-group with stannous chloride solution in an open flask and estimation of the excess of reducing agent with iodine was found to be unsatisfactory in the case of nitrated "solvent naphthas." The author finds, however, that if the nitro-compound is heated in a sealed tube with excess of stannous chloride solution (prepared by dissolving the dihydrated salt in twice its weight of 25 per cent. hydrochloric acid) at 120° for two hours, the tube being shaken every fifteen minutes, reduction is complete. The excess of stannous chloride is then determined by titration with decinormal iodine solution, using starch as indicator. It is of importance that exactly the same volume of stannous chloride solution should be used in all experiments and for the blank determination. Quoted analyses made by this method and by the combustion method on the same substances gave very concordant results.

AMONG forthcoming books of science we notice the following:—"The Future of Our Agriculture," H. W. Wolff (*P. S. King and Son, Ltd.*); "Dragons and Rain Gods, etc.," Prof. G. Elliot Smith (*Manchester University Press*); "Bibliography of the Geology and Eruptive Phenomena of the more Important Volcanoes of Southern Italy," the late Dr. H. J. Johnston-Lavis; "An Economic Geography of the British Empire," C. B. Thurston; "The New Regional Geographies, vol. iii., Europe and Africa," L. Brooks, and a new edition of "The Application of Hyperbolic Functions to Electrical Engineering Problems," A. E. Kennelly (*University of London Press, Ltd.*); "Problems of Reconstruction," papers read at the summer meeting held at the Hampstead Garden Suburb, August 3–17, 1917, with an introduction by the Marquess of Crewe; "Forestry Work," W. H. Whellans (*T. Fisher Unwin, Ltd.*); "The Year Book of Wireless Telegraphy and Telephony, including Map of the World showing Wireless Telegraph Stations, 1918" (*The Wireless Press, Ltd.*).

OUR ASTRONOMICAL COLUMN.

THE NEW WOLF PLANET.—An orbit of this body (which has been designated DB) has now been computed by Mr. G. Stracke, and its accuracy is confirmed by a recent Greenwich photograph:—

Perihelion passage 1918 January 3·617, G.M.T.

$$\left.\begin{array}{lrrr} \omega & 347^\circ & 46' & 15'' \\ \Omega & 110 & 54 & 1 \\ i & 8 & 57 & 41 \end{array}\right\} 1918{\cdot}0$$

$$\begin{array}{lrrr} \phi & 32 & 12 & 5 \end{array}$$

Period 4·025 years
Perihelion distance 1·182
Aphelion " 3·879

The perihelion distance is very little greater than that of Eros, but the period and eccentricity are much larger. In some revolutions the planet will suffer considerable perturbations by Jupiter, but there will be no near approach in the coming revolution. The fact that the period is very close to four years implies that there will be another near approach to the earth at the next return, of which possibly advantage might be taken to make a determination of the solar parallax. The planet, however, is a little too faint for this purpose, being only of the tenth magnitude in the most favourable circumstances. Its diameter can scarcely be more than four miles.

The orbit is of much the same type as that of Albert, discovered in 1911, but never seen since that year. The present body has been much better observed than

Albert was, so it should be possible to secure its re-observation.

The recent observations of Encke's comet show that the time of perihelion passage will be 1918 March 24·295, G.M.T., which is only 0·018 day earlier than Mr. Viljev's predicted value. By the time this appears it will be too near the sun for observation, and on its emergence it will be visible only to southern observers.

ERRATUM.—In the note on the comet of 1802 last week, *for* "August to October last" *read* "August to October, 1802."

A STAR WITH A NOVA SPECTRUM.—Dr. Max Wolf has announced that a star of magnitude 8·5 showing a Nova spectrum was photographed at Heidelberg on February 4. In Circular No. 3 of the Marseilles Observatory, the position of the star is given by M. Millosevich as R.A. 7h. 22m. 47·98s., declination −6° 30′ 40·8″; on February 23 the magnitude of the star was 9·1.

THE SHORT-PERIOD VARIABLE RZ CEPHEI.—From extensive photographic observations which have been made at Dunsink, Messrs. Martin and Plummer have deduced a period of 0·308646 day for this interesting variable star (Monthly Notices, vol. lxxviii., p. 156). A maximum is indicated by the observations at J.D. 2421496·616, and the range of variation is from magnitude 9·5 to 10·16. The period, of about 7·4 hours, is among the shortest known. The light curve shows a more rapid rise to maximum than fall to minimum, and the descending arm shows well-marked secondary waves. The phases of the harmonics show remarkable accordance with those of other short-period variables, and also with those of some of the long-period variables which are included in Group II. of the classification given by Phillips. It would thus appear possible that a common process operates in variables differing as widely as RZ Cephei, and stars with a range of some ten magnitudes and periods of the order of a year, or even the sun with its period of eleven years.

THE RAMSAY MEMORIAL FUND.

THE Lord Mayor of London has issued a special appeal to the citizens of London for support to the Ramsay Memorial Fund. Towards the 100,000*l.* which the Executive Committee aims at raising, the sum of about 31,000*l.* has been subscribed. The Lord Mayor points out that London has benefited largely in the past through Sir William Ramsay's connection with the City, and that great industrial advantages will be derived from the successful institution of the proposed memorial laboratory of engineering chemistry. He hopes, therefore, that there will be a generous response to his appeal.

It will be remembered that the principal objects of the Executive Committee of the memorial fund are to establish: (*a*) Ramsay memorial research fellowships in chemistry, tenable at any suitable place possessed of adequate equipment, and (*b*) a Ramsay Memorial Laboratory of Engineering Chemistry in connection with University College, London. Subscriptions may be earmarked for either of these purposes, or may be left, as regards their allocation, to the discretion of the committee. The president of the Ramsay memorial is Mr. Asquith, whilst the vice-presidents include the Prime Minister, Mr. H. A. L. Fisher, Sir J. J. Thomson, Lord Rayleigh, the Earl of Rosebery, Lord Reay, and Lord Gainford of Headlam. Lord Rayleigh is chairman of the General Committee, Sir Hugh Bell of the Executive Committee. The hon. treasurers are Lord Glenconner and Prof. Norman Collie. On the Executive Committee appear the names of many of the most eminent representatives of British chemical science and industry.

It is earnestly to be hoped that all friends and admirers of Sir William Ramsay and all supporters and well-wishers of chemical science will subscribe to the memorial. The work which Sir William Ramsay did as a great teacher and investigator will remain for all time as an imperishable monument to his genius, enthusiasm, and tireless industry. In the centuries to come his name will stand out as one of the greatest discoverers in the long annals of science.

British chemical science has indeed reason to be proud of the great name which has long been, and ever will remain, one of its brightest ornaments. The proposed memorial will not only serve to honour the work and memory of Sir William Ramsay, but will also be of the greatest value for the cause which he had most at heart, namely, the advancement of chemical science. This object scarcely requires emphasising at the present time. The well-being, health, prosperity, and civilisation of nations are dependent on the never-ceasing advance and application of chemical facts and principles. For this purpose every nation requires a host of scientifically trained chemists. The more we possess of such men, the greater will be our chances not merely of prosperity and well-being, but also of survival in the great race of the immediate future. It is, therefore, of vital importance to provide young men of promise and ability with every opportunity of continuing and improving their chemical studies. The Ramsay memorial research fellowships will enable such young men to continue their training and experience in chemical research at that period of their lives when such opportunities are of the greatest importance for their future competency and success. The Ramsay Memorial Laboratory of Engineering Chemistry will provide young chemists with the opportunity of learning how to apply the principles of chemical science in technical practice. Many of our chemists have been unable to apply their knowledge and abilities to the greatest advantage for lack of suitable preparatory training in the theory of practice, which is, essentially, a just comprehension of the engineering and economic aspects of a chemical reaction or process. This is a matter of urgent and pressing importance for the future of British chemical industry. The committee of the Ramsay Memorial Fund hopes, in the ways indicated above, to be able, not only to honour the memory of a great man, but also to further the advancement of chemical science and chemical practice.

Memoranda describing the memorial scheme have recently been addressed respectively to the Governments of the Dominions, Colonies, and Dependencies of the Empire and to those of the principal Allied and neutral countries. Each Government is invited to consider the possibility of providing from State funds at least one capital sum of 6000*l.*, which will be sufficient to found and maintain in perpetuity one Ramsay memorial fellowship of the value of 250*l.* a year, with an expenses grant of 50*l.* a year. The fellowship, it is proposed, will be tenable at any place in the United Kingdom possessed of the necessary equipment by a fully trained chemist from the Dominion, Colony, Dependency, or foreign State concerned. For Dominions like Canada and India one fellowship might scarcely be adequate; and it is hoped that some Governments will see their way to found, not one, but a group of fellowships.

The scheme is making good progress in countries outside Great Britain, and it is hoped that a substantial sum will be received from such countries. The Ramsay Memorial Committee has already appointed the following representatives outside Great Britain: Prof. Baskerville in America; Prof. Masson in Australia;

Prof. Inglis in New Zealand; Señor Augusto Villanueva in Chile; Prof. Guye in Switzerland; and Prof. H. Kamerlingh Onnes in Holland.

Subscriptions should be sent either to the Lord Mayor at the Mansion House, or to the Hon. Treasurer, Ramsay Memorial Fund, University College, Gower Street, London, W.C.1.

AURORA AND MAGNETIC STORM OF MARCH 7–8.

THE auroral display of Thursday last attracted much attention, partly because it coincided with an air-raid upon London. The northern sky was lighted up with a crimson glow both before and during the raid, which started shortly after 11 p.m.; and the appearance was thought by an observer at Folkestone to be due to a distant fire. Sir Napier Shaw informs us that the Meteorological Office has received reports of aurora observations from Lerwick, Stornoway, Eskdalemuir, Donaghadee, Liverpool, Clacton, and Southend. He has favoured us with the following account, by Dr. C. Chree, of the large magnetic disturbance recorded at the Kew Observatory between 9 p.m. on Thursday and 5 a.m. on the following morning. Mr. A. Lander has sent us photographic traces of movements in declination recorded at Canterbury during Thursday and Friday. Thursday's trace was remarkably even until shortly after 9 p.m., when the magnetic storm began. It is possible that the disturbance was a repetition, after three 27-day intervals, of the large magnetic storm of December 16–17, 1917. There was a very considerable disturbance on January 12 at the end of the first 27-day interval, and a minor disturbance at the end of the intermediate interval in February.

Dr. Chree writes: "A magnetic storm of no great duration, but very considerable amplitude, was recorded at Kew Observatory on the night, March 7–8, 1918. It began with a 'sudden commencement' at about 9h. 10m. p.m. on March 7. The largest movements occurred in the early morning of March 8, between midnight and 5 a.m., but smaller oscillations persisted for some time after the latter hour. The 'sudden commencement' was especially prominent in horizontal force (H); after a small, sudden fall there was a sharp rise of fully 60γ. The corresponding movements in declination (D) consisted of an oscillation of about 4′, the first movement being to the west. The range shown on the D trace was about 51′, the extreme easterly and westerly positions being reached at 2.20 a.m. and 4.16 a.m. respectively on March 8. Between 1.11 a.m. and 2.20 a.m. of the same day there was a movement of 36′ to the east. The range on the H trace was about 240γ. A very rapid downward movement commenced about 2.3 a.m. on March 8, the fall during the next thirty minutes amounting to fully 185γ. After 5 a.m. on the same day there were only short-period oscillations in H of moderate size; but up to 10 a.m. the element remained depressed by fully 70γ as compared with its value on the previous day before the storm."

MILITARY AERONAUTICS.

THE recent night raids on Paris by squadrons of Gotha machines brings the question of defence against such raids before us, and adds much interest to an article by Lieut. Jean-Abel Lefranc, who, writing in the *Revue Scientifique*, gives an excellent review of the development of German bombing machines, of which the latest type is the Gotha. He also surveys the various methods of defence that have been adopted, particularly against night raids. His article is full of interesting details, of which it is only possible to quote a few, and to recommend those who are interested to read the original in the *Revue Scientifique* for February 16. A detailed description of the Gotha machine is given, the overall weight being quoted as 84,000 lb., and the weight of bombs carried as about half a ton. The speed is given as ninety miles per hour, and the height to which the machine can rise after discharging its bombs is 20,000 ft. M. Lefranc also states that the Gotha is likely to be replaced by a "Gotha Riesenflugzeug," having four motors, and a span of about 130 ft. The "large Friedrichshafen Gotha" which was captured in one of the Paris raids can scarcely be one of these later machines, as it only had two motors of 250 h.p. each. The extreme difficulties of accurate bombing by night are commented upon, and the writer thinks that the demoralisation of industry is a more important result of night raids than the actual damage done. With regard to defence, camouflage, anti-aircraft guns, and attack by fighting machines are discussed, but M. Lefranc considers that all these methods are very ineffective, and that the best method of defence is to attack and destroy so far as possible the enemy's aviation centres. Commenting on extreme measures, such as total abolition of artificial lighting at night, he thinks they are a vain sacrifice to public opinion, and may even be a detriment to the Services. M. Lefranc concludes his well-written article with a picture of the bombing machine of the near future, pointing out that a machine of 1000 h.p., carrying two tons of explosives, is within the reach of modern design.

The *National Geographic Magazine* for February, published by the National Geographic Society, of Washington, U.S.A., should be read by all who are interested in the development of aviation and in the part which America is playing in the struggle for aerial supremacy. The whole of this attractive issue is devoted to matters of aeronautical interest, and the photographs which illustrate the articles are especially good. Three of the articles deal directly with American activity, and are entitled "America's Part in the Allies' Mastery of the Air," "Building America's Air Army," and "The Future of the Airplane." The second of these merits special attention, and is beautifully illustrated by no fewer than forty-three photographs. The first section deals with the actual construction of American machines, and the manufacture of their parts is described in some detail. Some really magnificent photographs follow, showing machines in flight and views obtained from aeroplanes, and the article concludes with a description of the training of aviators and the tests which they must pass before being pronounced expert pilots. The magazine also contains a number of descriptive articles giving the experiences of aviators in various countries, which make very interesting reading, but which it is impossible adequately to summarise in a short notice such as the present.

THE PRODUCTION OF FUEL OIL AND COAL-GAS.

MUCH attention has been devoted recently to developing the home production of fuel oil, the needs of the Navy and difficulties of transport rendering this imperative. Several well-informed articles have appeared in the Press, and the subject was dealt with in NATURE of February 28 (p. 506). Opinion is divided among experts as to the probability of finding petroleum in any quantity in this country, but Lord Cowdray, who has been so closely associated with the remarkable developments of the Mexican and other fields, has expressed the view that the prospects are distinctly promising, and has backed his opinion by making alternative offers on behalf of his firm to the Government, either to place the services of the firm's expert staffs at its disposal for the period of the war, free of cost, or to drill at the firm's own expense subject to certain areas being reserved to them. He estimated that this offer committed his firm to a probable expenditure of 500,000*l*. It is obvious that the first step should be to prove or disprove the existence of oil in paying quantities, under such regulations that national interests in any oil discovered are properly safeguarded. Details as to royalties, conditions of production, etc., can well wait for future settlement. The alternative to natural oil is production by distillation processes. For some years about three million tons of oil-shale have been produced in Scotland and retorted, but other oil-yielding minerals, such as coal, cannel-coal, and blackband ironstone, are possible sources. Large quantities of cannel are available, much of which is left in the mine or thrown on the dump as unsuitable for fuel, on account of its high ash content, which is seldom below 10 per cent. One ton of high-quality cannel may yield more than forty gallons of oil; the average yield may be taken as twenty gallons per ton; of this some 50–60 per cent. would be fuel oil. Such oils more nearly approach the natural petroleum products in composition than do the ordinary coal products, and also furnish good yields of valuable paraffin wax. An announcement appeared in the *Times* (March 8), bearing the impress of official origin, that tests on cannel in existing gasworks retorts have given satisfactory results, with extraordinarily high yields of fuel oil and ammonia. It is to be hoped that this foreshadows early production, since little extra retorting and collecting plant will be required.

Modern developments in gasworks construction and practice were described by Mr. Alwyne Meade in a paper read at the Institution of Civil Engineers on March 5. It appears that in spite of modern improvements, the introduction of scientific control, and the lavish installation of labour-saving machinery, coal-gas costs approximately as much to manufacture as it did thirty years ago. The expense of modern manufacture is solely attributed to the abnormal rise in the cost of coal and transport, while during the past three years the wages paid to employees have, in common with other industries, undergone considerable augmentation. Mr. Meade stated that the advances made in the practical application of the theory of heat interchange have resulted in an enormous saving of sensible heat. Whereas twenty years ago 28 lb. of coke were necessary for the carbonisation of 100 lb. of coal, to-day, with the modern continuous vertical retort, only 11½ lb. are required for dealing with the same quantity of coal. Attention was directed to present-day attempts to effect carbonisation on ideal lines by the continuous admission of a small quantity of coal to the retort, and the simultaneous extraction of an equal bulk of coke. The continuous vertical retort has been designed for this purpose, but Mr. Meade holds the opinion that as regards the results of carbonisation the horizontal retort is still able to hold its own in many respects. An advantage of the vertical retort is that it affords facilities for steaming the coal charge; thus, within limits, water-gas may be produced simultaneously with the evolution of coal-gas. Recent results indicate that by introducing the principle of "steaming," it is possible to increase the B.Th.U. produced per ton of coal from 6½ millions to nearly 8 millions, with a corresponding reduction in the quality of the gas amounting to only some 20 B.Th.U. per cubic foot. The coal reserves of this country are trifling compared with those of America and the Central Empires, from which it will be appreciated that there is no time to be lost in developing to the utmost advantage the natural gift upon which England's pre-eminence as a nation depends.

TECHNICAL INSTRUCTION IN SWITZERLAND.

IN the *Revue Scientifique* for November 3, 1917, there appears an interesting article by M. C. Perregaux on the progress of technical instruction in Switzerland. It is the second of two articles, the first of which dealt with the establishment, equipment, and work of the renowned Federal Polytechnic of Zurich, with its eleven divisions of applied science, and of the State-recognised School of Engineering at Lausanne, both of which are devoted to the training of the highest class of professional technicians. The present article deals with the aims and work of an intermediate class of schools known as "Technicums," and intended, each according to local industrial requirements, for the training of men aspiring to positions of industrial responsibility as foremen and managers. Six such schools come under review, namely, in German Switzerland: Winterthur, Berthoud, and Bienne; in French Switzerland: Geneva, Locle, and Fribourg.

In addition to these six day institutions, there are also in Switzerland 13 museums of industrial art, 164 schools of commerce, 27 trade schools for boys, 22 trade schools for girls, 342 special (fortbildung) schools for boys, and 720 for girls; in all 1294 institutions of a special or trade character devoted to the industrial well-being of Swiss citizens, an extraordinarily effective provision for a country of three and a half millions denied in large measure the possession of natural mineral resources and wholly dependent for the industrial and commercial well-being of its people upon facilities for a sound scientific and technical training based upon an efficient system, universally accessible, of elementary and secondary education.

It was in 1883 that the Swiss Confederation decided to aid by means of grants, and also to supervise, the existing meagre means of trade instruction in certain instances, and in 1884 gave a subsidy of 40,000 francs to forty-three institutions, with a total expenditure of 440,000 francs, but so rapid has been the development of these institutions that in 1904 they had increased to 318, with an expenditure of 3,940,000 francs, towards which the subventions from the State amounted to 1,080,000 francs; and there were in 1916 1294 such institutions supervised and aided by the State. The six "Technikums" under consideration form a link between the trade schools (Gewerbeschulen), so-called, and the training given in the Federal Polytechnic at Zurich or the Engineering School at Lausanne.

The activity of Germany, and especially of the neighbouring State of Württemberg, in the provision of technical instruction seriously alarmed the Confederation, since it had the possibility of displacing certain Swiss industries, and it led therefore to the initiation of measures calculated to avert the peril. The chief of these "Technikums," which vary in type and seek to adapt themselves to regional conditions, is at Winterthur, some thirteen miles from Zurich, founded in 1874. The other five have been established since 1890, three of them since the beginning of the century.

The course of instruction in Winterthur covers six semesters, and includes architecture, mechanical and electrical engineering, roads and bridges, chemistry, commerce, and railway work. Students on entrance must have had a secondary-school course and be not less than fifteen years of age. The staff comprises forty professors with fourteen assistant lecturers, and the students in all departments were 556 in 1916. The fees for instruction are 30 francs for each semester, together with certain special fees, and foreigners are charged treble fees. The six schools have a total of 2427 students, and are fully equipped with laboratories for experimental instruction. On leaving these schools the students enter the Union of Swiss Technicians, which association now counts its members by thousands and has for its organ the *Swiss Technical Review*, which publishes much good original work. Altogether these institutions have proved a great success and have been of material benefit in training a large body of men for the industries, many of whom have afterwards qualified for high industrial or administrative positions at home or abroad.

GRAVITATION AND THE PRINCIPLE OF RELATIVITY.[1]

II.

WE have to admit, then, that a world-line can be bent by the proximity of other world-lines. It can also be bent, as you see, by the proximity of my thumb. The suggestion arises, May not the two modes of bending be essentially the same? The bending by my thumb (a mathematical transformation of space and time) is in a sense spurious; the world-line is pursuing a course which is straight relative to the *original* material. Or we may perhaps best put it this way—the world-line still continues to take the shortest path between two points, only it reckons distance according to the length that would be occupied in the unstretched state of the bladder. It is suggested that the deflection of a world-line by gravitation is of the same nature; from each world-line a state of distortion radiates, as if from a badly puckered seam, and any other world-line takes the shortest course through this distorted region, which would immediately become straight if the strain could be undone. The same rule —of shortest distance as measured in the undistorted state—is to hold in all cases. This is a mode of reasoning which has often been fruitful in scientific generalisations. A magnetic needle turns towards the end of a bar-magnet; it also turns towards a spot near the pole of the earth; hence the suggestion that the earth is a magnet. We assume the essential identity of the two modes of deflecting the needle. It is a daring step to apply the analogy and assume the essential identity of the two ways of deflecting world-lines; but at any rate we shall make this assumption and see what comes of it.

You will see that according to this view the earth moves in a curved orbit, not because the sun exerts any direct pull, but because the earth is trying to find the shortest way through a space and time which have been tangled up by an influence radiating from the sun. We can continue to describe this indirect influence of the sun on the earth's motion as a "force"; but, assuming that it makes itself felt as a modification or strain of space and time, we are able to bring the discussion of the laws of this force into line with the discussion of the laws of space and time, *i.e.* the laws of geometry. Needless to say, we could not determine a physical law like the law of gravitation by geometrical reasoning without making some assumption.

I am afraid that to talk of a force as being a distortion of space and time must at first appear to you hopeless jargon. But it must be remembered first that we are not concerned with any metaphysical space and time. We mean by space and time simply a scaffolding that we construct as the result of our measures; and if anything queer happens to our measuring apparatus, the scaffolding may easily go crooked. Taking our everyday conception of space, we should say that this room is at rest; we have been told that it is being carried round the earth once a day, but in practical life we never pay any attention to that. The space that we naturally use is thus different from, and it is not difficult to show that it is distorted as compared with, the more fundamental astronomical space in which this room is travelling at a great velocity. So our scaffolding is crooked. But, it may be asked, in what way can this distortion of our space-scaffolding be regarded as a force? The answer is quite simple. We perceive it as a force, and that is the only way in which we do perceive it. We do not perceive that this room is being carried round by the earth's rotation, but we perceive a certain force—the earth's centrifugal force. It is rather difficult to demonstrate this force, because gravitation predominates overwhelmingly; but if gravity were annihilated we should have to be tied down to the floor to prevent our flying up to the ceiling, and we should certainly feel ourselves pulled by a very vigorous centrifugal force. That is our only perception of the crookedness of our scaffolding.

We often call the centrifugal force an "unreal" force, meaning that it arises simply from a transformation of the framework of reference. Can we feel confident that gravitation is in any sense more "real"? In effect they are so much alike that even in scientific work we speak of them in one breath. What is called the value of gravity in London, 981·17 cm./sec.^{2}, is really made up partly of the true attraction of the earth and partly of the centrifugal force. It is not considered worth while to make any distinction. Surely, then, it is not a great stretch of the imagination to regard gravitation as of the same nature as centrifugal force, being merely our perception of the crookedness of the scaffolding that we have chosen.

If gravity and centrifugal force are manifestations of the same underlying condition, it must be possible to reduce them to the same laws; but we must express the laws in a manner which will render them comparable. There is a convenient form of Newton's law, which was given by Laplace and is well known to mathematicians, which describes how the intensity at any point is related to the intensity at surrounding points—or, according to our interpretation, how the distortion of space at any point fits on to the distortion at surrounding points. It is evidently an attempt to express the general laws of the strains in space and time which occur in Nature. If we are correct in our assumption that gravitation involves ***nothing more*** than strain of space-time,[2] so that its law expresses merely the relation between adjacent strains which holds by some natural necessity, clearly the strains which give the centrifugal force must obey the same general law. Here a very interesting point arises. We cannot reconcile the Newtonian law of gravitation with this condition. Newton's law and the law of centrifugal force are contradictory.

To put the matter another way, if we determine the strains by Newton's law, we get results closely agreeing with observation, provided Minkowski's space-time is used; but if we avail ourselves of our right to use a transformed space-time, the results no longer agree with observation. That means that Newton's law involves something which is not fully represented by strains, and so does not agree with our assumption. We must abandon either our assumption, or the famous law which has been accepted for more than

[1] Discourse delivered at the Royal Institution on Friday, February 1, by Prof. A. S. Eddington, F.R.S. Continued from p. 17.

[2] The idea is that matter represents a seam or nucleus of strain, and the strains at other points link themselves on according to laws inherent in the *continuum* and quite independent of the matter. The matter starts the strain, but does not *control* it as it goes outwards.

200 years, and find a new law of gravitation which will fall in with our requirements.

This amended law has been found by Einstein. It appears to be the only possible law that meets our requirements, and in the limited applications which come under practical observation is sufficiently close to the old law that has served so well. In practical applications the two laws are indistinguishable, except for one or two crucial phenomena to which reference will be made later. But in gravitational fields far stronger than any of which we have experience, and for bodies moving with velocities much greater than those of the planets, the difference would be considerable.

This idea of the distortion of space as the *modus operandi* of gravitation has led to a practical result—a new law of gravitation. It is not brought in as a hypothetical explanation of gravitation; if Einstein's theory is true, it is simply of the nature of an experimental fact.

If we draw a circle on a sheet of paper and measure the ratio of the circumference to the diameter, the result gives, if the experiment is performed accurately enough, the well-known number π, which has been calculated to 707 places of decimals. Now place a heavy particle at or near the centre and repeat the experiment; the ratio will be not exactly equal to π, but a little less. The experiment has not been performed, and is not likely to be performed, because the difference to be looked for is so small; but, if Einstein's theory is correct, that must be the result. The space around the heavy particle does not obey ordinary geometry; it is non-Euclidean. The change in its properties is not metaphysical, but something which, with sufficient care, could be measured. You can keep to Euclidean space if you like, and say that the measuring-rod has contracted or expanded according as it is placed radially or transversely to the gravitational force. That is all very well if the effect is small, but in a very intense gravitational field it would lead to ridiculous results like those we noticed in connection with the Michelson-Morley experiment—everything expanding or contracting as it changed position, and no one aware of any change going on. I think we have learnt our lesson that it is better to be content with the space of experience, whether it turns out to be Euclidean or not, and to leave to the mathematician the transformation of the phenomena into a space with more ideal properties.

This consequence of the new law of gravitation, though theoretically observable, is not likely to be put to any practical test either now or in the immediate future. But there are other consequences which just come within the range of refined observation, and so give an immediate practical importance to the new theory, which has indeed scored one very striking success. If we could isolate the sun and a single planet, then under the Newtonian law of gravitation the planet would revolve in an ellipse, repeating the same orbit indefinitely. Under the new law this is not quite true; the orbit is nearly an ellipse, but it does not exactly close up, and in the next revolution the planet describes a new ellipse in a slightly advanced position. In other words, the elliptic orbit slowly turns round in the same direction in which the planet is moving, so that after the lapse of many centuries the orbit will point in a different direction. The rate at which the orbit turns depends on the speed of motion of the planet in its orbit, so we naturally turn to the fastest moving planets, Mercury, Venus, and the earth, to see if the effect can be detected. Mercury moves at thirty miles a second, Venus at twenty-two, the earth at eighteen and a half. But there is a difficulty about Venus and the earth. Their orbits are nearly circular, and you cannot tell in which direction a circle is pointing. Mercury combines the favourable conditions of a high speed and a satisfactorily elongated orbit the direction of which at any time can be measured with considerable precision. It is found by observation that the orbit of Mercury is advancing at the rate of 574 seconds of arc a century. This is in great measure due to the attraction of the other planets, which are pulling the orbit out of shape and changing its position. The amount of this influence can be calculated very accurately, and amounts to 532 seconds per century. There is thus a difference of forty-two seconds a century unaccounted for; and this has for long been known as one of the most celebrated discordances between observation and gravitational theory in astronomy. It is thirty times greater than the probable error which we should expect from uncertainties in the observations and theory. There are other puzzling discordances, especially in connection with the motion of the moon; but the conditions in that case are more complicated, and I scarcely think they offer so direct a challenge to gravitational theory. Now Einstein's theory predicts that there will be a rotation of the orbit of Mercury additional to that produced by the action of the planets; and it predicts the exact amount—namely, that in one revolution of the planet the orbit will advance by a fraction of a revolution equal to three times the square of the ratio of the velocity of the planet to the velocity of light. We can work that out, and we find that the advance should be forty-three seconds a century—just about the amount required. Thus, whilst the Newtonian law leaves a discordance of more than forty seconds, Einstein's law agrees with observation to within a second or so.

Of course this superiority would be discounted if we could find some other application where the old Newtonian law had proved the better. But that has not happened. In all other cases the two laws agree so nearly that it has not been possible to discriminate between them by observation. The new law corrects the old where the old failed, and refrains from spoiling any agreement that already exists. The next best chance of applying the new theory is in the advance of the orbit of Mars; here Einstein's new law "gilds refined gold" by slightly improving an agreement which was already sufficiently good—a "wasteful and ridiculous excess," which is at any rate not unfavourable to the new theory.

There is another possibility of testing Einstein's theory, which it is hoped to carry out at the first opportunity. This relates to the action of gravitation on a ray of light. It is now known that electromagnetic energy possesses the property of inertia or mass, and probably the whole of the mass of ordinary matter is due to the electromagnetic energy which it contains. Light is a form of electromagnetic energy, and therefore must have mass—a conclusion which has been found true experimentally, because light falling on any object exerts a pressure just as a jet of water would. We ordinarily measure mass in pounds, and it is quite proper to speak of "a pound of light," just as we speak of a pound of tobacco. In case anyone should be thinking of going to an electric light company to buy a pound of light, I had better warn you that it is a rather expensive commodity. They usually prefer to sell it by a mysterious measure of their own, called the Board of Trade unit, and charge at least 3*d*. a unit. At that rate I calculate that they would let you have a pound of light for 141,615,000*l*. Fortunately, we get most of our light free of charge, and the sun showers down on the earth 160 tons daily. It is just as well we are not asked to pay for it.

But although light has mass, it does not follow that light has weight. Ordinarily, mass and weight are associated in a constant proportion, but whether this is so in the case of light can be settled only by experiment—by weighing light. It seems that it should be just possible to do this. If a beam of light passes an object which exerts a gravitational attraction, then, if it really has weight, it must drop a little towards the object. Its path will be bent just as the trajectory of a rifle bullet is curved owing to the weight of the bullet. The velocity of light is so great that there is only one body in the solar system powerful enough to make an appreciable bend in its path, namely, the sun. If we could see a star close up to the edge of the sun, a ray of light coming from the star would bend under its own weight, and the star would be seen slightly displaced from its true position. During a total eclipse stars have occasionally been photographed fairly close to the sun, and with care it should be possible to observe this effect. There is a magnificent opportunity next year when a total eclipse of the sun takes place right in the midst of a field of bright stars. This is the best opportunity for some generations, and it is hoped to send out expeditions to the line of totality to weigh light according to this method.

In any case, great interest must attach to an attempt to settle whether or not light has weight. But there is an additional importance, because it can be made a means of confirming or disproving Einstein's theory. On Einstein's theory light must certainly have weight, because mass and weight are viewed by it as two aspects of the same thing; but his theory predicts a deflection twice as great as we should otherwise expect. Apart from surprises, there seem to be three possible results:—(1) A deflection amounting to 1·75″ at the limb of the sun, which would confirm Einstein's theory; (2) a deflection of 0·83″ at the limb of the sun, which would overthrow Einstein's theory, but establish that light was subject to gravity; (3) no deflection, which would show that light, though possessing mass, has no weight, and hence that Newton's law of proportionality between mass and gravitation has broken down in another unexpected direction.

The purpose of Einstein's new theory has often been misunderstood, and it has been criticised as an attempt to explain gravitation. The theory does *not* offer any explanation of gravitation; that lies quite outside its scope, and it does not even hint at a possible mechanism. It is true that we have introduced a definite hypothesis as to the relation between gravitation and a distortion of space; but if that explains anything, it explains not gravitation, but space, *i.e.* the scaffolding constructed from our measures. Perhaps the position reached may be made clearer by another analogy. Let us picture the particle which describes a world-line as hurdle-racer in a field thickly strewn with hurdles. The particle in passing from point to point always takes the path of least effort, crossing the fewest possible hurdles; if the hurdles are uniformly distributed, corresponding with undistorted Minkowskian space, this will, of course, be a straight line. If the field is now distorted by a mathematical transformation such as an earthquake so that the hurdles become packed in some parts and spread out in others, the path of least effort will no longer be a straight line; but it is not difficult to see that it passes over precisely the same hurdles as before, only in their new positions. The gravitational field due to a particle corresponds with a more fundamental rearrangement of the hurdles, as though someone had taken them up and replanted them according to a law which expresses the law of gravitation. Any other particle passing through this part of the field follows the guiding rule of least effort, and curves its path, if necessary, so as to jump the fewest hurdles. Now, we have usually been under the impression that when we measured distances by physical experiments we were surveying the *field*, and the results could be plotted on a map; but it is now realised that we cannot do that. The field itself has nothing to do with our measurements; all we do is to count hurdles. If the only cause of irregularity of the hurdles were earthquakes (mathematical transformations), that would not make much difference, because we could still plot our counts of hurdles consistently as distances on a map; and the map would represent the original condition of the field with the hurdles uniformly spaced. But the more far-reaching rearrangement of hurdles by the gravitational field forces us to recognise that we are dealing with counts of hurdles and not with distances; because if we plot our measures on a map they will not close up. The number of hurdles in the circumference of a circle[3] will not be π times the number in the diameter; and when we try to draw on a map a circle the circumference of which is less than π times its diameter, we get into difficulties—at least in Euclidean space. This analogy brings out the point that the theory is an explanation of the real nature of our measures rather than of gravitation. We offer no explanation why the particle always takes the path of least effort—perhaps, if we may judge by our own feelings, that is so natural as to require no explanation. More seriously, we know that in consequence of the undulatory theory of light, a ray traversing a heterogeneous medium always takes the path of least time; and one can scarcely resist a vague impression that the course of a material particle may be the ray of an undulation in five dimensions. What concerns gravitation more especially is that we have offered no explanation of the linkages by which the hurdles rearrange themselves on a definite plan when disturbed by the presence of a gravitating particle; that is a point on which a mechanical theory of gravitation ought to throw light.

From the constant of gravitation, together with the other fundamental constants of Nature—the velocity of light and the quantum of action—it is possible to form a new fundamental unit of length. This unit is 7×10^{-28} cm. It seems to be inevitable that this length must play some fundamental part in any complete interpretation of gravitation. (For example, in Osborne Reynolds's theory of matter this length appears as the mean free-path of the granules of his medium.) In recent years great progress has been made in knowledge of the excessively minute; but until we can appreciate details of structure down to the quadrillionth or quintillionth of a centimetre, the most sublime of all the forces of Nature remains outside the purview of the theories of physics.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The syndicate appointed to consider the Previous examination has issued its report. The recommendations involve changes which, if passed by the Senate, will greatly alter the present character of the examination. The syndicate advises the discontinuance of Greek as a compulsory subject, and recommends that every candidate shall be required to take at least one paper in natural science. It proposes that the examination should be in three parts: (1) Languages; (2) mathematics and natural science; (3) English subjects. In part (1) it is recommended that Latin should continue to be a compulsory subject, and that a candidate should be required to take one other foreign language, namely, Greek, French, German, or Spanish,

[3] A circle would naturally be defined as a curve such that the number of hurdles (counted along the path of least effort) between any point on it and a fixed point called the centre is constant. To make the vague analogy more definite, we may suppose that the hurdles are pivoted, and swing round automatically to face the jumper; he is not allowed to dodge them, *i.e.* to introduce into his path sinuosities comparable with the lengths of the hurdles

In part (2) it is proposed that six papers should be set (two in mathematics and four in natural science subjects—experimental science, physical geography, biology, botany), of which a candidate would be required to take three, one, at least, of these being a mathematical paper, and no candidate would be allowed to take both biology and botany.

LIVERPOOL.—The University of Liverpool has recently received a gift of 2000*l.* from Mrs. and Miss Holt as a contribution towards the cost of equipment of the new department of geology. Prof. Boswell is to be congratulated upon the excellent beginning that academic geology is able to make at Liverpool in consequence of this gift. Moreover, the new department has been enriched by the presentation of valuable collections of books, maps, and geological specimens. Among the specimens are included the collections of rocks, minerals, and fossils made by the late G. H. Morton (together with his manuscript catalogue), the collections of the late Dr. R. C. Ricketts and Joseph Lomas, besides other smaller miscellaneous collections. The departmental library of geology includes a large series of periodicals, both British and foreign, the publications of the local British geological societies being of especial interest. The late T. Mellard Reade's large collection of geological pamphlets finds an appropriate home in the department, and a valuable gift of books and periodicals from the library of the late R. H. Tiddeman has recently been presented by his widow. Furthermore, for some years past Prof. W. A. Herdman has been collecting together an important series of maps and periodicals in anticipation of the establishment of the School of Geology.

OXFORD.—An anonymous donor has sent 500*l.* to Sir William Schlich towards the fund for the permanent endowment of the professorship of forestry.

In a Convocation held on March 12 the degree of D.Sc., *honoris causa,* was conferred upon Prof. W. C. M'Intosh, for many years professor of natural history in the University of St. Andrews.

SOME interesting details are given in *La Nature* for February 9 concerning the present activity of the University of Grenoble. As is well known, Grenoble is situated practically in the centre of the hydro-electric industry of France, and much of the work of the Polytechnic Institute connected with the University has a bearing on the branches of science which are concerned in the new industries arising from the use of hydro-electric energy. The polytechnic comprises (1) a higher electrotechnic college for the training of electrical engineers, electrometallurgists, and electrochemists; (2) an elementary school of electrotechnics; (3) a mechanical and electrical testing laboratory for commercial tests; (4) a school for training engineers for the paper trade; (5) a laboratory for tests and analyses connected with the paper trade; and (6) an electrometallurgical and electrochemical test station, and a model plant of 1000 h.p. A chair of electrochemistry and electrometallurgy has also been created. It is stated that the polytechnic is also open to receive students from foreign countries.

PARTICULARS given in the issue of the U.S. *Monthly Weather Review* for June of last year concerning meteorological courses for aeronautical engineers have been published at Washington as a separate pamphlet. The National Advisory Committee for Aeronautics, co-operating with the United States War Department, arranged in May, 1917, with a number of leading universities and schools for courses designed specially to further the education and training of aviators. These courses, technically known as "Ground Schools in Military Aeronautics," include such subjects as elementary meteorology, astronomy, engineering, internal-combustion engines, and so on, and are now being offered at Massachusetts Institute of Technology in co-operation with Harvard University, Princeton University, Cornell University, Ohio State University, University of Illinois, University of Texas, and the University of California. Prof. R. DeC. Ward is giving the course in meteorology at the Massachusetts Institute of Technology, and also a more extended course forming part of the requirements leading to the degree of aeronautical engineer. The syllabus of work includes, in addition to the general principles of meteorology, a study of atmospheric conditions affecting aviation, forecasts of wind velocity and direction aloft, and favourable and unfavourable weather for flying.

THE governing body of the Manchester School of Technology has decided to change the name to Manchester College of Technology. The progress of the college fully justifies the change in name, which at the same time will remove a possible misconception as to the nature and scope of the activities of the institution. In the two years immediately before the war the number of matriculated students in the college increased by 50 per cent., and though the war has drawn away more than two-thirds of its students, to-day there are actually more undergraduates than there were in 1911–12. The proportion of evening students doing the most advanced work doubled itself between 1913 and 1916; and even to-day, after two years of the Military Service Acts, the proportion is 60 per cent. greater than it was in 1911–12. To enable the college to attract and retain experts of first-rate ability whose services are in great demand by industrial concerns, the governing body is now offering professorial salaries up to 1000*l.* or 1200*l.* a year, with permission to undertake private consulting work under suitable conditions. According to official data, the annual expenditure of the college is now about equal to that of the University of Sheffield, and is half as large again as that of the University of Bristol. But perhaps the greatest change of all is in the quantity of the research work undertaken. This result is in part due to the fact that the governing body now offers annually several research scholarships, each of the value of 100*l.* a year. Moreover, lecturers are appointed not only to teach, but also to research; they understand that their advancement largely depends upon their research. Co-operative researches in which the practical experience of individual manufacturers is combined with the wider but less specialised knowledge of members of the college are increasing in number.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 28.—Sir J. J. Thomson, president, in the chair.—Hon. R. J. **Strutt**: Scattering of light by dust-free air, with artificial reproduction of the blue sky. (1) By proper arrangement of the experimental conditions, it is possible to observe the scattering of light by pure air, free of dust, in a small-scale laboratory experiment. (2) Similar results can be obtained with other gases. Hydrogen gives much less scattering than air, oxygen about the same, carbon dioxide decidedly more. (3) The scattered light in air and in all the other gases is blue—the blue of the sky—illustrating very directly the theory that attributes the blue of the sky to scattering by the molecules of air. Tyndall obtained the blue by means of fine-grained fogs, precipitated from organic vapours. This was a valuable contribution, but his fogs were, of course, both chemically and physically very different from dust-free air. (4) The scattered light is almost completely polarised.—Dr. J. R. **Airey**: The Lommel-Weber Ω function and its application to the problem of electric waves on a thin anchor ring.—W. **Harrison**: Investigations on textile fibres. (1) Dry fibres, when subjected to stress, exhibit a kind of plasticity in which the strains produced remain when the stress is removed, but are accompanied by corresponding internal stresses. (2) Fibres deformed in the above manner return to their original shape when placed in cold water. (3) Fibres in contact with cold water are elastic; strains produced by the application of stress disappear when that stress is removed, more quickly with some fibres than with others. (4) In boiling water fibres are plastic, and the application of stress produces permanent deformation with no corresponding internal stresses in the case of wool and only slight stresses with other fibres. (5) The double refraction exhibited by the natural fibres is due to the presence of internal stresses. (6) The swelling produced by treatment of cotton fibres with solutions of sodium hydrate and of wool fibres with sulphuric acid is due to the internal stresses naturally present in those fibres. (7) The internal stresses present in natural fibres appear to originate in the moulding of the fibres during growth and in their subsequent drying, and can be imitated experimentally with artificial fibres.—W. L. **Cowley** and H. **Levy**: Critical loading of struts and structures. This paper is concerned with the elastic stability of structures composed of members under compression, and treats problems relating to the strength of such a construction as a beam under end thrusts and supported at intermediate points. The investigation shows that failure does not necessarily occur when one of the bays is of Euler's lowest critical length. In this instance, however, the two equations of three moments involving this bay take an indeterminate form and must be replaced by two other equations which can easily be derived. The structure will not fail, in general, through the bending moments becoming excessive, even if several of the bays are of Euler's critical length, provided at least one bay is not of that length.

Geological Society, February 15.—Annual general meeting.—Dr. A. Harker, president, in the chair.—The **President**: Anniversary address. The present position and outlook of the study of metamorphism were discussed. For the first time it seems possible to approach the subject of metamorphism systematically from the genetic point of view. For the geologist this implies the critical study, not only of the great tracts of crystalline schists and gneisses, but equally of metamorphic aureoles, of pneumatolysis and other contact-effects, and of the phenomena, mechanical and mineralogical, related to faults and overthrusts. It implies, moreover, the recognition that these are all parts of one general problem, that of the reconstruction of rocks under varying conditions of temperature and stress. This problem is complicated by the fact that perfect adjustment of chemical equilibrium cannot be assumed, either in the rocks prior to metamorphism, or during the process of metamorphism itself. The most fundamental characteristic of metamorphism was considered, namely, that recrystallisation takes place in a solid environment, and so may be profoundly affected by the existence of shearing stress. Stress of this type arises from the crystal growth itself, and is called into play by external forces. The automatic adjustment of the internally created stress to neutralise that provoked from without affords the key to all structures of the nature of foliation. The mineralogical peculiarities characteristic of the crystalline schists must find their explanation in kindred considerations; for it can be shown that the chemistry of bodies under shearing stress differs in important respects from the chemistry of unstressed bodies. The result is seen in the appearance of a certain class of "stress-minerals" where the dynamic element has figured largely in metamorphism, while in the same circumstances the formation of minerals of another class seems to have been inhibited. The conditions governing metamorphism are temperature and shearing stress, with uniform pressure as a factor of less general importance. If the orogenic forces are sufficient to maintain shearing stress everywhere at its maximum, the stress itself becomes a function of temperature, since this determines the elastic limit, and the principal conditions of metamorphism come to depend upon a single variable. This degree of simplification, however, is not to be expected universally.

February 20.—G. W. Lamplugh, president, in the chair.—Prof. W. M. **Davis**: The geological aspects of the coral-reef problem. A voyage in the Pacific, in 1914, enabled the author to collect new evidence bearing upon this question, and to make observations that have influenced him in his support of Darwin's theory. All theories that postulate a fixed relation between reef-formation and ocean-level are disproved, and are inapplicable to the case of atolls. Reef-upgrowth is intimately associated with submergence wherever the matter can be tested. The solution of the coral-reef problem turns, at present, upon some means of discriminating between a submergence caused by subsidence, and a submergence caused by a general rise of the ocean-level due either to the uplift of the ocean-floor beyond the coral-reef region, or to the melting of the Pleistocene ice-sheets. Reasons to regard changes in ocean-level as of secondary importance are presented, and the submergence demanded by self-encircled islands is attributed to local subsidence, in accordance with the views of Darwin and Dana. It is concluded that fringing-reefs do not mark stationary or rising islands so generally as Darwin supposed. With regard to elevated reefs, the impossibility of explaining their features by regarding them as having been stationary while the ocean-surface was lowered is demonstrated, and it is held that they must be due to local and diverse uplift affecting the islands themselves, following on epochs of subsidence which were the epochs of reef-formation. The theory that such reefs were formed during pauses in the elevation and emergence is considered to be seriously defective, and is contrary to Darwin's views.

Zoological Society, February 19.—Dr. A. Smith Woodward, vice-president, in the chair.—L. A. **Lantz**: A collection of reptiles made in Transcaspia and now in the Zoological Museum of Moscow University.—Prof. E. W. **MacBride**: Recent investigations into the development of the sea-urchin (*Echinocardium cordatum*).

Physical Society, February 22.—Prof. C. H. Lees, president, in the chair.—T. **Smith**: A note on the use of approximate methods in obtaining constructional data for telescope objectives. The paper discusses the reason why satisfactory telescope objectives are obtained by neglecting thicknesses and solving for freedom from first-order aberrations. It is shown that the introduction of thicknesses into such an objective without any alteration in the curvatures of the surfaces yields a lens corrected for aberration for a zone which is a constant fraction of the full aperture obtainable. For objectives of the usual type this zone is very approximately the one that would be selected for correction to obtain the most favourable balance between first- and second-order aberrations. It follows that objectives calculated from first-order formulæ in which thicknesses are neglected do not require trigonometrical verification or correction unless the conditions are very abnormal.—Dr. H. S. **Allen**: A suggestion as to the origin of special series. The paper gives a development of an idea put forward in an earlier paper, describing an atomic model with a magnetic core. It is assumed that the principle of the constancy of angular momentum may be applied to the *total* angular momentum of the electron, and a certain part of the core bearing a special relation to the electron. On the lines of Bohr's theory this leads to an expression for the oscillation frequency, which is similar to Rydberg's formula, and contains a constant which is the same for all elements. The "phase" μ of a "sequence" is regarded as proportional to the angular momentum of a definite portion of the core. In observed series the phases of the two sequences are not equal to one another; consequently, whatever interpretation be given to the phase, the two types of state concerned must be in some way different from one another. When the magnetic field of the core is taken into account, a formula is obtained which is identical with that of Ritz. An explanation of the series of enhanced lines in spark spectra is also suggested.

CAMBRIDGE.

Philosophical Society, February 4.—Prof. Marr, president, in the chair.—Major P. A. **MacMahon**: Certain integral equations.—G. H. **Hardy**: (1) Sir George Stokes and the concept of uniform convergence. (2) Note on Mr. Ramanujan's paper entitled "Some Definite Integrals."—G. N. **Watson**: Asymptotic expansions of hypergeometric functions.—S. **Ramanujan**: (1) Certain trigonometrical sums and their applications in the theory of numbers. (2) Some definite integrals.

February 18.—Prof. Marr, president, in the chair.—Prof. S. **Gardiner** and Prof. **Nuttall**: Fish-freezing. The authors advocate the creation of a vast store of frozen herrings against times of scarcity, instead of the herrings being pickled and exported. The value of fish as food is weight for weight about the same as meat, containing the same constituents.—P. **Lake**: Shell deposits formed by the flood of January, 1918. During the flood of January 20 a remarkable and extensive deposit of shells was laid down by the Cam on the towpath near the railway bridge below Cambridge. Most of the shells belonged to the genus Limnæa, but other genera, both land and fresh-water, also occurred. The freedom from silt of much of the deposit suggests that even a muddy river may form a limestone as pure as the fresh-water limestones of the Purbeck series.—G. **Matthai**: (1) Reactions to stimuli in corals. The series of movements which take place in the soft parts of colonies in response to chemical and tactile stimuli are of the nature of amœboid or streaming movement of protoplasm, the soft parts themselves appearing to serve as the medium for the conduction of stimuli. (2) Is the Madreporarian skeleton an extraprotoplasmic secretion of the Polyps? In 1899 Bourne supported von Koch's view that the Madreporarian skeleton is formed as an extraprotoplasmic secretion of the calicoblastic layer of ectoderm, and entirely disagreed with von Heider's suggestion that it is the result of the deposition of carbonate of lime within calicoblasts. The organic matrix revealed on slow decalcification of thin sections of Coralla, and regarded by Bourne as due to the disintegration of calicoblasts, is probably part of the living calicoblastic sheet in which calcareous matter has been laid down, as otherwise it is difficult to understand how the manifold skeletal types of the Madreporaria can have arisen. Skeletal formation in the Madreporaria would then be homologous to spicule formation in the Alcyonaria—*i.e.* intraprotoplasmic.—H. H. **Brindley**: Notes on certain parasites, food, and capture by birds of *Forficula auricularia*. There seems no ground for attributing male dimorphism in earwigs to infection by gregarines. Though earwigs are always spoken of as garden pests, there appear to be but scanty records of the plants they prefer. During last August and September a large number kept in captivity in the zoological laboratory were given three kinds of plants together for several days at a time to ascertain the favourites, with the following results:—Vegetable marrow leaves much eaten; horseradish leaves very little; Michaelmas daisy leaves and flowers not at all; beetroot leaves much eaten; phlox flowers also; dwarf bean leaves but little; white rose and blue Anchusa petals much attacked, their leaves neglected; golden rod leaves eaten, but flowers untouched; yellow Œnothera petals much eaten, pods untouched; white Japanese anemone flowers somewhat nibbled, leaves untouched; raspberry leaves not eaten, but the hairy undersides a most favourite hiding place; cabbage leaves very thoroughly gnawed; rhubarb leaves a good deal; scarlet-runner flowers, pods, and foliage untouched. Plum fruit was readily attacked, but apples and potatoes in their skins remained untouched even when no other food was given for a week. When cut across both were eaten, potato much more than apple. Newstead (*Supp. Journ. Board of Agric.*, December, 1908) reports the presence of earwigs in the alimentary canal of only ten out of 128 species of British birds the food of which was examined. Theobald and McGowan (*loc. cit.*, May, 1916), investigating the food of the starling month by month during 1912–14, found 353 earwigs in 748 birds. An analysis of their records reveals that more earwigs were taken from October to March than from April to September, though most male earwigs die and the females are hibernating during the latter period. This fact is puzzling, though it may be that the starling is driven to search for buried earwigs in the absence of other insect food. Stone curlew and sparrows have been found to eat earwigs, but there is no doubt that this insect is little molested by wild birds. Domestic fowls eat it readily.

PARIS.

Academy of Sciences, February 4.—M. Paul Painlevé in the chair.—The president announced the death, on February 2, of M. E. Yung, correspondant for the section of anatomy and zoology.—E. **Ariès**: Formula giving the pressure of the saturated vapour of a monatomic liquid. A formula derived from an equation of state given in a previous communication is applied to the cases of crypton, xenon, and argon. A comparison of the calculated and observed figures shows good agreement, with the exception of one temperature for argon, for which an error of experiment is suggested as the cause of the deviation.—G. A. **Boulenger**: The oldest Characinidæ, and its signification from the point of view of the present distribution of this family.—P. **Barbarin**: The dilemma of J. Bolyai.—P. **Fatou**: Functional equations and the properties of certain boundaries.—A. **Denjoy**: The curves of M. Jordan.—D. **Pompeiu**: A definition of holomorphic functions.—R. de Montessus de **Ballore**: Skew quartics of the first series.—A. **Mailhe** and F. de **Godon**: A new catalytic method for the formation of nitriles. Ammonia and the vapours of an aldehyde are passed over thoria at about 430° C., when hydrogen is evolved and a nitrile produced, according to the equation

$$R.CHO + NH_3 = R.CN + H_2O + H_2.$$

*iso*Amyl nitrile, *iso*butyl nitrile, propionitrile, benzonitrile, and anisonitrile have been prepared by this reaction.—L. **Gentil**, M. **Lugeon**, and L. **Joleaud**: The geology of the Sebou basin (Morocco).—Mlle. Y. **Dehorne**: The analogies of the branched form in the polypes constructing reefs at the present time with the stromatopores of the secondary strata.—A. **Guilliermond**: Plasmolysis of the epidermal cells of the leaf of *Iris germanica*. The epidermal cells of the leaf of this Iris form an exceptionally favourable object for the cytological study of plasmolysis. The effects produced by solutions of sugar and of common salt of various concentrations are detailed.—H. **Colin**: The genesis of inulin in plants. Studies on inulin formation and migration in chicory, dahlia, and Jerusalem artichoke.—J. **Gautrelet** and E. **Le Moignic**: Contribution to the physiological study of the antityphoid vaccines in aqueous solution. An experimental study on the dog of the changes in the blood-pressure caused by the injection of various typhoid and paratyphoid vaccines.—MM. **Tuffier** and **Desmarres**: Studies on the cicatrisation of wounds.

BOOKS RECEIVED.

Originality: A Popular Study of the Creative Mind. By T. S. Knowlson. Pp. xvi+304. (London: T. W. Laurie, Ltd.) 15*s*. net.

The Spleen and Anæmia. By Prof. R. M. Pearce, with the assistance of Dr. E. B. Krumbhaar and Prof. C. H. Frazier. Pp. x+419. (Philadelphia and London: J. B. Lippincott Co.) 21*s*. net.

Principles and Practice of Milk Hygiene. By Prof. L. A. Klein. Pp. x+329. (Philadelphia and London: J. B. Lippincott Co.) 12*s*. 6*d*. net.

Annual Reports on the Progress of Chemistry for 1917. Issued by the Chemical Society. Vol. xiv. Pp. ix+264. (London: Gurney and Jackson.) 4*s*. 6*d*. net.

Lectures on the Principles of Symmetry and its Application in all Natural Sciences. By Prof. F. M. Jaeger. Pp. xii+333. (Amsterdam: "Elsevier" Publishing Co.)

Mathematics for Engineers. Part i., including Elementary and Higher Algebra, Mensuration and Graphs, and Plane Trigonometry. By W. N. Rose. Pp. xiv+510. (London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

British Birds. Written and illustrated by A. Thorburn. Supplementary Part. Pp. 11. (Longmans and Co.) 6*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 14.

ROYAL SOCIETY, at 4.30.—An Expansion of the Point-Potential: A. W. Conway.—The Lunar and Solar Diurnal Variations of Water Level in a Well at Kew Observatory, Richmond: E. G. Bilham.

ROYAL SOCIETY OF ARTS, at 4.30.—English Commerce with India, 1608–1658: William Foster.

INSTITUTE OF METALS, at 4.—The Relationship between Hardness and Constitution in the Copper-rich Aluminium-Copper Alloys: J. Neill Greenwood.—Aluminium-Bronze Die Casting: H. Whittaker and H. Rix.—On Grain Size: Dr. G. H. Gulliver.—Lead-Tin-Antimony Alloys: Owen W. Ellis.—An Investigation on Unsound Castings of Admiralty Bronze (88:10:2): Cause and Remedy: Prof. H. C. H. Carpenter and Miss C. F. Elam.

MATHEMATICAL SOCIETY, at 5.—The Representation of a Number as the Sum of any Number of Squares: G. H. Hardy.—A Problem in the Theory of Numbers: G. N. Watson.

OPTICAL SOCIETY (Imperial College of Science and Technology), at 8.—The Detection of Ghosts in Prisms: T. Smith.

FRIDAY, MARCH 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Employment of Women in Munition Factories: Miss O. E. Monkhouse and Ben. H. Morgan.

SATURDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

MONDAY, MARCH 18.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Possibility of Aerial Reconnaissance in the Himalaya: Dr. A. M. Kellas.

ARISTOTELIAN SOCIETY, at 8.—Realism and Politics: J. W. Scott.

TUESDAY, MARCH 19.

ROYAL INSTITUTION, at 3.—The Climatic Adaptation of Black and White Men: Dr. Leonard Hill.

ROYAL STATISTICAL SOCIETY, at 5.15.—The Bases of Local Taxation in England: E. J. Harper.

ZOOLOGICAL SOCIETY, at 5.30.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Further Discussion:* Modern Developments in Gasworks Construction and Practice: A. Meade.—*Paper:* The Derwent Valley Waterworks: E. Sandeman.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Russian Petroleum Industry and its Prospects: D. Ghambashidze.

MINERALOGICAL SOCIETY, at 5.30.—Graphical Operations with Four Independent Variables: Prof. E. S. Federov.—Lattice-like Inclusions in Calcite from North Burgess, Ontario: R. P. D. Graham.—On Linear Rock-diagrams: Dr. J. W. Evans.

WEDNESDAY, MARCH 20.

ROYAL SOCIETY OF ARTS, at 4.30.—The Food Situation in Germany: P. Shuttlewood.

GEOLOGICAL SOCIETY, at 5.30.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Address by the President: The Earl of Durham, K.G.—Standard Cargo Ships: Sir George Carter.—The Most Suitable Sizes and Speeds for General Cargo Steamers: J. Anderson.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Measurement of Atmospheric Pollution: Dr. J. S. Owens.

THURSDAY, MARCH 21.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—The Mechanical Design and Specification of the Turbo-alternator Rotor: Dr. S. F. Barclay.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Annual General Meeting.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Problems of the Future in the Design and Construction of Merchant Ships: W. S. Abell.—Research in Marine Engineering: A. E. Seaton.—The Effect of the Longitudinal Motion of a Ship on its Statical Transverse Stability: G. S. Baker and Miss E. M. Keary.—At 3 p.m.—The Iron Carbon Equilibrium Diagram and its Practical Usefulness: Prof. H. C. H. Carpenter.—Stress Distribution in Bolts and Nuts: C. E. Stromeyer.

LINNEAN SOCIETY, at 5.—The Shoulder-girdle of a Dicynodont Reptile from South Africa: E. S. Goodrich.—Fossil Charas from Oligocene Beds: J. Groves.—Malayan Form of *Chlorococcum humicola* (Nacq.), Rabenh.: Miss B. Muriel Bristol.

FRIDAY, MARCH 22.

ROYAL INSTITUTION, at 5.30.—Radiation from System of Electrons: Sir J. J. Thomson.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—A Preliminary Survey of the Possibilities of Reinforced Concrete as a Material for Ship Construction: Major M. Denny.—Reinforced Concrete Vessels: W. Pollock.—Design and Construction of a Self-propelled Reinforced Concrete Sea-going Cargo Steamer building in Great Britain: T. G. O. Thurston.—An Investigation of the Shearing Force and Bending Moment acting on the Structure of a Ship including Dynamic Effects: A. M. Robb.—At 3 p.m.—Air Supply to Boiler Rooms: R. W. Allen.

SATURDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, MARCH 21, 1918.

THE ATOM OF ELECTRICITY.

The Electron: Its Isolation and Measurement and the Determination of Some of its Properties. By Prof. R. A. Millikan. (University of Chicago Science Series.) Pp. xii+268. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1917.) Price 1.50 dollars net.

THE great advances in physical science that have been made during the past twenty years have been largely based on the idea that electricity, like matter, is not infinitely divisible, but that there exists a definite fundamental unit of electrical charge or "atom of electricity" which is incapable of further subdivision, and that all charges, however great, are integral multiples of this unit. While the great mass of experimental observation strongly supported this idea, it has been extremely difficult, as in the case of so many fundamental theories, to obtain a direct and convincing proof of its truth.

In the present monograph Prof. Millikan, of the University of Chicago, gives a most interesting and complete account not only of the general history of this idea, but also of the methods that have been developed to determine, with an accuracy, it is believed, of one in a thousand, the magnitude of the fundamental unit of charge or atom of electricity. When we consider that the atom of electricity is probably the most fundamental and important physical constant in Nature, it is a great triumph for experimental science to have devised within so short a time methods capable of such accuracy. It is to Prof. Millikan himself that we are indebted for the final successful methods of attack of this most difficult problem, and in this monograph we have the advantage of obtaining a first-hand account of his difficulties and triumphs.

From the title of the book, "The Electron," it might be inferred that the author dealt with the general properties of the electron and its *rôle* in electric phenomena. This, however, is not the case, for the first half of the book contains an account of experiments to prove the existence of an atom of electricity and to measure its value, and the latter half is devoted to problems of atomic structure and radiation. There is, however, some historical justification for the title, since the late Johnstone Stoney, when he first introduced the name "electron" in 1891, restricted its meaning to the actual magnitude of the unit charge, quite apart from the mass or properties of the carrier itself, which at that time were quite unknown. While the original meaning has to some extent been conserved, there is now a general tendency to restrict the term "electron" to those atoms of disembodied negative electricity like the cathode particles and β particles of radium which have an apparent mass small compared with that of the hydrogen atom. When the smallest mass associated with the atom of positive electricity has been fixed, it would naturally be termed the "positive electron." So far, however, there appears to be a fundamental distinction between positive and negative electricity, for the atom of positive electricity has never been found associated with a mass less than that of the hydrogen atom. Whether the nucleus of the hydrogen atom is in reality the positive electron or whether it may prove a complex is still an unsettled question.

After a simple sketch of the history of the subject, the author passes in careful review the pioneer methods of J. S. Townsend, Sir J. J. Thomson, and H. A. Wilson for measuring the unit of charge carried by electrified drops of water, and points out the inherent difficulties of accurate measurement under these conditions. The methods employed by Prof. Millikan were similar in general principle to those used in these early researches, with one important distinction. Instead of measuring the average charge carried by a multitude of water drops, subject to variation of size by condensation or volatilisation, he confined his attention to a single charged drop of oil or mercury of small diameter.

A sprayer was used to produce fine drops of oil or mercury, and some of these, charged by friction, fell through a small opening into the space between two charged parallel and horizontal plates, and came into view of a microscope as bright points of light. By adjustment of the electric field a single drop of this kind could be held suspended in the field of view of the microscope for hours at a time. The charge on the drop could be determined from observations on the electric field required to balance the drop, and the velocity of fall of the drop under gravity. The drop usually carried a number of unit charges either positive or negative. By an ingenious method he was able to vary and even reverse this charge at will. For this purpose the drop was allowed to pass for a short time into a region where there was an excess of ions of one sign produced by radium rays and separated by an electric field. In this way it was possible to unload the charge of the drop unit by unit, and to measure it after each exposure. By direct experiment of this kind the author was able to show definitely that all charges gained or lost by the drop were either single or integral values of a definite unit, and still more that the original charge produced on the drop by friction was an integral number of this unit. In this way he was able to prove a number of fundamental points in a most direct way; for example, that the unit of charge produced by friction is the same as the charge carried by the ion in gases, while the unit of positive charge was shown to be identical with the unit of negative charge within a very small margin of error.

As a result of five years' work involving a complete study of numerous corrections, the value e of the atom of electricity was found to be $e=4{\cdot}774\times10^{-10}$ electrostatic units, with a probable error of not more than one in a thousand. With the knowledge of this constant it is easy to deduce at once the value of a number of other important magnitudes with equal precision, *e.g.* the number of molecules in a cubic centimetre of any gas at standard pressure and temperature, and the mass of each of the atoms of matter. At the same time, the accurate evaluation of e throws light on the magnitude of a number of related quantities.

While Prof. Millikan's work was in progress, Ehrenhaft examined the charge carried by particles so small that they showed a marked Brownian movement, and concluded that the charge in some of these cases was smaller than the value found by Prof. Millikan, or, in other words, that there existed a charge less than that carried by the negative electron or gaseous ion. This evidence is carefully examined by the author, who concludes that the discrepancies can be readily accounted for by experimental disturbances, and that there is no trustworthy evidence of the existence of a sub-electron.

Later chapters include a discussion of modern views of the structure of the atom and the nature of radiant energy. Very appreciative references are made to the value of Moseley's work, and its great importance in fixing the relation and modes of vibration of the elements is emphasised. The author is a supporter of the nucleus theory of the structure of the atom, and outlines clearly Bohr's contributions to the origin of spectra.

Prof. Millikan's book is written in a simple, almost popular, style. The argument throughout is well sustained, and the essential points are clearly brought out. Stress is laid on the underlying physical ideas, and the few calculations required are included in an appendix. We can recommend this volume most strongly both to scientific experts and to the general scientific public as an accurate and at the same time inspiriting account of an important field of scientific inquiry opened up in recent years.

E. R.

A STUDY OF THE JEWISH CHILD.

The Jewish Child: Its History, Folklore, Biology, and Sociology. By W. M. Feldman. With introduction by Sir James Crichton-Browne. Pp. xxvi+453. (London: Baillière, Tindall, and Cox, 1917.) Price 10*s.* 6*d.* net.

DR. FELDMAN'S study of the Jewish child should be of interest to English readers for at least two reasons. First, because out of a total of twelve million Jews in the world, one-fifth are, at present, living in English-speaking countries—more than two millions in America, and less than a quarter of a million (240,000, to be exact) in the United Kingdom. The second reason is that the British Government, with the consent of the Allies, proposes to use its best endeavours to establish, under the ægis of the British Government, a national home for the Jewish people in Palestine, where they might be at liberty to develop in accordance with their national aspirations.

Dr. Feldman is well qualified to lead us in the study of the Jewish child; for not only is he well acquainted with modern Jewish child-life, having a big practice among the Jews of Whitechapel, but he is also well versed in Jewish literature, ancient and medieval. His book represents the first attempt to give a comprehensive account of Jewish child-life in all its phases and aspects, and takes us through the whole life-cycle of the Jewish child, including the ante-natal, natal, and post-natal periods.

The book may be divided roughly into two parts, historical and scientific. The historical part deals with the state of knowledge of child-life among the ancient and medieval Jews. By means of numerous quotations and citations from the Bible, the Talmud, and Rabbinical literature, the author demonstrates, first that the Jews were keenly interested in all the phases of child-life, and secondly that the amount of true knowledge they possessed on this subject was not inconsiderable. For it must be noted that the broad principles of eugenics and hygiene were strictly enforced by the laws of Moses, and repeatedly enjoined by the teachings of the Rabbis as a religious duty. The scientific part, on the other hand, deals with such questions as the physical, biological, and pathological characteristics of the modern Jewish child.

One of the most important chapters in the book is that which discusses the vital statistics of the Jewish child. At a time when the problem of infant mortality looms large in the public eye, it is interesting to note that among Jews the infant mortality is, at all ages of child-life, considerably lower than among the general population, and not only in England, but in all other countries. The chances of surviving the critical first year are also much greater among Jewish infants. Contrary to the popular belief, the Jewish birth-rate is less, and yet their degree of increase is greater, than that of non-Jews. This is because their infant mortality is considerably lower. As Leroy-Beaulieu puts it, the Jews "bring fewer children into the world, but they bring more of them to maturity." "This low infantile mortality," Dr. Feldman reminds us, "is not due to any inherent racial vitality in the Jewish child, but is due to the almost universal prevalence of breast-feeding among Jewesses, to the lesser incidence or almost entire absence of transmissible taints resulting from diseases acquired by the parents in the worship of Venus and Bacchus, and lastly to the great general care bestowed on their children by Jewish parents, who fly to the doctor for almost every infantile ailment."

The chapter on the system of education among the Jews proves how highly education was valued by them so far back as 2000 years ago. This zeal for education, both Jewish and secular, is still very marked among the Jewish population of the East End. Among other subjects, the author discusses the effects of first-cousin marriages among the Jews. He also gives us an interesting and lucid account of the recent study of Jewish physiognomy by Dr. Redcliffe Salaman, who came to the conclusion that the Jewish type of face is a recessive Mendelian character, a conclusion which has a bearing on the question of intermarriage and the purity of the Jewish race.

One or two criticisms must be made on an otherwise excellent book. A number of misprints occur, and the author repeats himself occasionally in a way that must affect unpleasantly the attentive reader. Some of the quotations are naïve and often irrelevant to the main purpose of the book. The whole chapter on the mathematical problems of the Talmud is outside the scope of the book. In general, one must say that the author gives too much, and one often wonders whether he is writing about the Jewish child or the Jewish family. Finally, is it to be taken as a compliment to our French Allies that the author gives most of the "indecent" quotations in French? This prudery is perhaps out of place in a scientific book. But these minor imperfections can, no doubt, easily be remedied, and we hope that this excellent compilation will be rendered more perfect in a second edition, which the book richly deserves.

J. BRODETSKY.

OUR BOOKSHELF.

The Linacre Lecture on the Law of the Heart. Given at Cambridge, 1915. By Prof. E. H. Starling. Pp. 27. (London: Longmans, Green, and Co., 1918.) Price 1s. 6*d*. net.

IN this lecture Prof. Starling has embodied the main results of the researches which he has carried out during the last few years on the work of the heart. The starting point of the investigation was the introduction by Knowlton and Starling of the heart-lung preparation by means of which the output and efficiency of the heart could be accurately studied under practically normal conditions. By this method the influence of changes in arterial and venous pressure on the output and volume of the heart, its oxygen supply, and its efficiency have been gradually worked out. The evidence obtained from this many-sided research has gradually led up to general conclusions of fundamental importance, one of which gives the lecture its title, and states that "the energy of contraction" of cardiac muscle "is a function of the length of the muscle fibre." In fact, the longer the fibres at the beginning of systole, the stronger is the force of the beat. This property of cardiac muscle, which is equally manifested by skeletal muscle, makes clear, for the first time, the real nature of the so-called "reserve power" of the heart. A rise of arterial pressure or an increase in venous inflow produces a greater diastolic volume of the heart—that is to say, an increased length of its fibres; the heart therefore contracts more forcibly, thereby maintaining its output against a high arterial pressure, or increasing its output when the venous inflow becomes larger.

This principle is not merely of physiological value, but also of far-reaching importance in pathology, and although the author only hints at this aspect, it must have an enormous influence on the clinical treatment of many diseases of the heart.

Plant Materials of Decorative Gardening: The Woody Plants. By Prof. W. Trelease. Pp. 204. (Urbana: Published by the Author, 1917.)

PROF. TRELEASE'S object in this little hand- or pocket-book is an attempt to make it possible for a careful observer to learn the generic and usually the specific names of any hardy tree, shrub, or woody climber that may be found cultivated in the eastern United States—excluding the extreme south—or in northern Europe except in the more pretentious estates or botanical establishments. The manual, which is of a convenient size, has been very carefully and thoughtfully compiled. Some 247 genera and 782 species, with a number of minor forms, are dealt with—in all, 1150 distinct kinds of plants belonging to eighty-three natural families. The book opens with dichotomous keys to the genera, which have been found to work very well, and are followed under each genus by keys to the species, a description of each genus being given before the keys. In addition to the Latin names, the common names of the plants are also given.

For the gardens of eastern North America no doubt the keys to the species are ample, but for Great Britain in many cases they are too meagre. Under Cotoneaster, for instance, of the six species mentioned only one, *C. microphylla*, is commonly found in our gardens, while many familiar species cultivated in this country are omitted. Berberis affords another example, as our gardens are getting filled with new introductions from China, of which no mention is made.

The principle of the manual is good, however, and in such features as it may be lacking we have other books to hand which fill its gaps. One of its chief merits is the vast amount of information it compresses into a small space.

There is a useful glossary at the end, and also a carefully prepared index.

Laboratory Glassware Economy. A Practical Manual on the Renovation of Broken Glass Apparatus. By Prof. H. B. Dunnicliff. Pp. x+92. (London: Macmillan and Co., Ltd., 1917.) Price 4s. net.

To overcome the great difficulty experienced by teachers of practical chemistry in Indian colleges in procuring supplies of glassware during the war, Prof. Dunnicliff devised a number of easy methods of renovating and adapting to new uses damaged apparatus made of glass. In this workmanlike little book he describes the processes he has developed and explains how difficulties may be surmounted with success. Teachers in charge of chemical laboratories at home will find the volume very useful, and the uses for damaged calcium chloride tubes, broken test-tubes, flasks, retorts, burettes, and so on, will show them how they may both effect economy and maintain efficiency.

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.]*

International Catalogue of Scientific Literature.

The Conjoint Board of Scientific Societies, some time last year, appointed—by what mandate is not clear—an International Catalogue Sub-Committee "to obtain information regarding the extent of the use made by scientific men of the present International Catalogue of Scientific Literature, and to obtain recommendations for possible improvement." The sub-committee consisted of Dr. Chalmers Mitchell, Mr. C. V. Boys, and Mr. E. B. Knobel, in addition to the official members. The sub-committee appears to have gone outside the terms of reference and to have reported "that it was advisable to consider suggestions for an alternative scheme." On February 25, the secretary of the sub-committee sent out a circular letter to certain scientific and technical societies, from which I reproduce the three opening paragraphs:—

"A sub-committee of the Conjoint Board of Scientific Societies has been for some time engaged in considering the future of the International Catalogue of Scientific Literature.

"As the outcome of several meetings the sub-committee is prepared to recommend that all papers and books dealing with both pure and applied science should be catalogued by authors and subjects, and that it is more practicable for such a catalogue to be prepared by a single country than by an international organisation.

"In order to bring this about, the sub-committee is considering a plan for the establishment of a central institution in London which shall assemble all the material required to be catalogued, and shall prepare from it cards showing (1) author; (2) title; (3) date and full references; (4) branch of science."

It will be noted that the committee has quietly put the International Catalogue and its organisation aside, and has acted as if the former were a negligible quantity and the catalogue defunct!

The history of the International Catalogue is briefly as follows. In 1893 the Royal Society was memorialised to take into consideration the preparation of complete author and subject catalogues, by international co-operation, in continuation of the society's Catalogue of Scientific Papers, which the society did not propose to continue beyond the century. The proposal being viewed with favour, the Royal Society solicited the opinion of scientific workers all over the world. There was practically but one reply—that such catalogues were essential, and almost universal agreement that the only way of carrying the work into execution was by international co-operation. Representative committees were appointed, and after two years of very hard work a scheme was prepared which was forwarded abroad, together with the invitation to attend the first international conference on the subject. This was held in July, 1896. Two subsequent international conferences were held in London in October, 1898, and June, 1900. All three were highly representative. Ultimately it was decided, at the third conference, to establish the catalogue as an international enterprise. Work was begun in 1901, and has been continued up to the present time. The organisation has grown steadily in weight and efficiency, and at the beginning of the war there were thirty-four regional bureaux in operation. The harmony which has prevailed throughout among the nations is one of the most remarkable features of the enterprise: notwithstanding the complexity of the work, there has not been the slightest friction. I believe no other international enterprise of like magnitude has been called into existence or worked more smoothly.

There is no doubt that the original establishment of the organisation was effected almost solely owing to the prestige of the Royal Society. The society has always been the responsible publishing agent, and is therefore financially liable.

The one chief difficulty in the way, which has retarded the work, has been the lack of working capital, owing to the fact that most Governments will only pay for the volumes after delivery. This has been met in part by a rather heavy loan from the Royal Society, on which interest has to be paid. The late Dr. Mond was one of the most ardent supporters of the catalogue and a convinced believer in international co-operation as the only effective means of producing a satisfactory result; he bequeathed a large sum to the Royal Society. I know that one of the chief objects he had in mind was to enable the society, when the bequest became available, to release the international enterprise from its indebtedness, and generally to promote the undertaking.

As war went on, it became necessary for the society to evaluate its responsibilities towards the catalogue. It was decided that the society could not guarantee the publication of the catalogue beyond the fourteenth issue. An issue consists of seventeen volumes, each dealing with a separate science. The fourteenth issue is now being published, and it is noteworthy that special contributions in aid of publication have been made by the Carnegie Foundation of New York, by the Department of Scientific and Industrial Research, and by certain private donors.

The Royal Society has also undertaken the direct control of the enterprise during the period of the war. Early last year it was intimated to workers abroad that the future of the catalogue must be left for the decision of an international council to be called as soon as possible after the conclusion of peace.

Why the Conjoint Board has intervened is not clear. It certainly has no right to give the catalogue its quietus. That it should have taken the action it has *without ever consulting the international organisation* passes belief. I attended the meeting of the board on Wednesday last, and protested most strongly against the discourtesy the sub-committee has displayed towards our Allies and the neutral countries concerned in the enterprise.

It is unnecessary to dwell on the special need at the present time of maintaining and cementing relationships that have been so happily established, and to comment further on the unhappy policy adumbrated by the sub-committee.

Henry E. Armstrong,
Chairman of the Executive Committee of the International Council.
Central Bureau of the International Catalogue,
34–35 Southampton Street, Strand, London.

Mercury's Perihelion Progress.

If Mercury sweeps up solar matter in its course round the sun—such matter as yields the Zodiacal light, for example—there will be no effect on its transverse or centripetal acceleration, but it will experience tangential retardation. This, if uniform, so that $m=a+b\theta$, would give a spiral character to the orbit; but if the sweeping up were periodic, with the planet's period, the orbit would suffer cumulative perturbations of the ordinary *de* and *ed*ϖ type.

Now, considering the eccentricity of Mercury's orbit, it seems quite possible that at perihelion it may sweep up more matter than at aphelion; and, if so, the perturbation caused would be roughly parallel to the minor axis, so that it would give a large *ed*ϖ and a small *de*. Which is what is wanted.

Perhaps also the fact that the Zodiacal light is best seen from the earth's position early in March indicates that the hypothetical matter extends mainly in the direction of Mercury's perihelion, which corresponds with the position of the earth early in December, for that would be at right angles to the March line of vision.

Probably this idea, in some form or other, has been already mooted by astronomers in connection with Mercury's outstanding discrepancy, and rejected by them on the ground that no sweeping up of matter was permissible which would exert any perceptible influence on the periodic time. It may be questioned, however, whether such minute influence could be recognised, otherwise than by its cumulative syntonic fluctuations, if it had been on the average uniform throughout recent centuries.

March 11. OLIVER LODGE.

The British Association and the Nation.

MAY I, as an outsider deeply interested in the organisation and use of competent knowledge in the nation's business, thank NATURE for the note in its issue of March 7 on the decision of the council of the British Association to suspend for yet another year the association's corporate life? I do not challenge the opinion of the Cardiff Committee, nor would I criticise the disinclination of the council, when so many of its prominent members are working hard at urgent problems, to hold a meeting of the customary peace type. But why should there not be a meeting suitable to a time of war and of real peril? Would it not be wise to show that the association stands for something in the stress of a great storm? I would respectfully suggest that a two days' meeting be arranged this year in London, and that two things be attempted thereat:—

(1) To elicit authoritative statements, so far as they can be made, of the services scientific men have rendered the country they have done so much to save from extinction, the extent to which these services have been improvised, and the circumstances in which they have been contributed.

(2) To make possible equally cogent statements illustrative of the future dependence of this country upon competent and organised knowledge, and hard and persistent effort on scientific lines, if its people are to be fit for their place and equal to their duty.

Facts are abundant; demonstrators are available; the time is opportune; the audiences are assured.

Imagine the verdict if nothing of this sort is attempted; a verdict passed on its own purpose by the British Association. The material interests can have their conferences—political, financial, industrial. Even the occupational categories can assemble, be voluminously reported and advertised, and pass resolutions of interminable length on matters far removed either from their knowledge or their experience. One interest only—that of competent and ascertained knowledge—the supreme need of an honest white race, fails the nation. Those who know are to be silent!

Will not that be the truth?

I feel certain that a group of students could easily put a different complexion on the matter, and I suggest that they should be permitted to try. As practically interested in administration, it would be a great privilege to assist in many ways open to me.

If the British Association, by reason of its constitution, finds it difficult to organise such a meeting, are there no other associations or groups of workers who will play their part? J. J. ROBINSON.

The West Sussex Gazette, Arundel, March 11.

Whales and Seals as Food.

MUCH correspondence has recently taken place regarding the use of whale flesh as food, but the writers, regarding it as an experiment or as a last resort, have overlooked the fact that for centuries it formed a regular diet of the islanders of Scotland. In both the western and northern isles the capture of the round-headed porpoise, or "ca'aing whale," has for long been a systematised industry, whenever opportunity offered, and indeed the earliest evidence of man's presence in Scotland, in Neolithic times, is associated with the demolition of a whale stranded on the shores of the Firth of Forth.

Seals also formed a staple food of the islanders, a slaughter of 200 or 300 being no unusual reward for a visit to Suleskerry, in the Orkneys, or to Haskeir, in the Outer Hebrides, during the eighteenth century. To this destruction is mainly to be attributed the decline of the grey seal in Scottish waters, which made necessary the legislative protection granted in 1914. In Martin's day (1703) the seal flesh was preserved for winter use, but difficulties accompanied the eating of it:—"The Natives salt the Seals with the ashes of burnt Sea Ware, and say they are good Food, the Vulgar eat them commonly in Spring time with a long pointed Stick instead of a Fork to prevent the strong smell which their Hands would otherwise have for several Hours after." It was not only the vulgar who feasted, however, for an innocent make-believe adapted the unusual fare to the palates of the great:—"The Seal, tho' esteemed fit only for the Vulgar, is also eaten by Persons of Distinction, though under a different name, to wit, Hamm." JAMES RITCHIE.

Edinburgh, March 15.

THE EDUCATION (NO. 2) BILL.

THE course of the debates in the House of Commons on Wednesday, March 13, and on Monday last, when the second reading was taken, augurs well for the passage of the new Education Bill into law. With one or two exceptions, which might in any circumstances have been expected, every speaker accepted cordially the proposals embodied in the measure, and some even went so far as to regret that more drastic changes had not been submitted, having regard to the grave position in which the nation finds itself, not merely from an industrial and commercial point of view, but also in respect of the responsibilities, personal and public, which the coming generation must perforce accept if we are to maintain and enhance our pride of place among the nations of the earth. Nothing is more gratifying to read in the course of an animated and informing debate than the all but unanimous demand from all parties for a better-paid teaching body with a much improved status. Without doubt the Bill is but a tentative measure, far exceeding, however, the most sanguine hopes of ardent educationists prior to the war. Let it be remembered how many Education Bills since the Act of 1902 have proved still-born or abortive.

The present Bill has at least achieved one victory: it has killed "half-time" for children under the age of fourteen years, and will thus bring into full-time education in the schools upwards of 207,000 children (who are now either partially or wholly excluded), to their manifest great advantage. The Lancashire and Yorkshire textile employers have almost unanimously accepted the inevitable judgment on this iniquitous system. The Bill further proposes, as perhaps its cardinal feature, and upon which serious opposition will concentrate itself, to establish the means of continued education within working hours for young persons between the ages of fourteen and eighteen years, by requiring at least eight hours per week during forty weeks of each year, or a total of 320 hours, to be devoted to their physical, mental, and moral training.

The necessity for such a measure, having regard to the large expenditure upon public elementary education, which must otherwise largely fail of its purpose, is to be seen in the fact that at the present time, despite the provision now made in evening classes, there are considerably more than $2\frac{1}{2}$ millions of our youth between twelve and eighteen years of age who have ceased all opportunities of education, many of whom grow up uncared for in large measure in body, mind, and soul. There are those who, like the Workers' Educational Association, deeply regret that opportunity has not been taken to place before Parliament and the people at this crucial time a measure of a much more drastic and far-reaching character. They regard the time as opportune for great and vital changes in the sphere of education. They point out the ineffectiveness and unfruitful results of our elementary education, how it is little better than a blind alley lacking organic relation with the system of secondary schools, to which fewer than 5 per cent. of the children in public elementary schools in England proceed; that the provision of secondary education and the facilities for enjoying it are lamentably deficient, and, even when taken advantage of, are pursued to such small effect that the school life of a secondary-school boy is but two years and nine months, and of a girl two years and eleven months, and that the average leaving age of boys is only fifteen years and seven months, and of girls sixteen years, a large number ceasing to attend the secondary schools at all after fourteen.

This reacts upon institutions of higher learning with disastrous results, seeing that from the secondary schools upon the grant list in England and Wales in 1910 only 1008 pupils went forward to the universities, being 2·2 per cent. of the total number (44,934) who left secondary schools in that year.

Of these, more than half (51·66 per cent.) were ex-elementary-school children. As 600,000 children leave the elementary schools annually, only about one per thousand receive a university education, and so unequally are the facilities distributed for such advanced training that more than one-half of the 566 boys passing from English public secondary schools to the universities come from three counties, and there are actually three counties which contribute no candidates at all.

It is doubtless true that many of the proposals of the Bill, which are now merely permissive, should be made mandatory, as, for example, the provision of nursery schools, open to all children whose parents wish them to attend; the duty of making adequate provision for medical and dental treatment; and of providing the means of physical training, baths, and playing fields.

Other desirable features would be the prohibition of all employment of children for profit or wages during the compulsory full-time school period; the provision of maintenance allowances; the raising of the elementary-school age to fifteen within a defined period; the abolition of fees in secondary schools; the continued education for practically half-time for all young persons not receiving full-time education; the serious limitation of the hours of labour for young persons below eighteen years of age; reduction in the size of classes in elementary schools to forty, and ultimately to thirty; an increase in the amount of State grant to 75 per cent., where all the conditions of a satisfactory provision for education are fulfilled, together with provision for the continued education of children who, being less than fourteen, left school before the Act comes into force, as well as that large body of children, estimated at 600,000, who have been exempted from school attendance during the war.

It is satisfactory to find that the Bill is to be committed to a Committee of the whole House, where it will have the advantage of public debate, and where a number of amendments will be submitted, not all of them with a view to its improvement, but rather with the purpose of delay and of ultimate defeat. Mr. Fisher, who has shown conspicuous zeal and industry in the advocacy of his measure, and would doubtless welcome any agreed amendments widening its scope, will need all the help of its friends to ensure its safe passage through the House. The measure is without question a considerable advance, and may be regarded as a step towards the realisation of the ideals to which the best friends of education for all the people aspire. "We have," said Mr. Fisher in the course of the debate, "in this country a continual wastage of ability, of character, and of physique. That is the principal evil which it is proposed to remedy in this Bill. In other words, this Bill acclaims the principle of the rights of youth. We hold that young people have a right to be educated, and that youth is the period specially set apart for that purpose. . . . The State must make up its mind as to the minimum of the education that its citizens should receive, and then require that minimum to be given."

BEE DISEASE.

IN the article which appeared in NATURE of August 23, 1917 (vol. xcix., p. 507), upon the above subject, it was pointed out that, as popularly used at all events, the expression "Isle of Wight disease" connotes not so much a disease as a group of diseases, due to different organisms. The cause of this misuse of the term is the inability of the honey-bee to express otherwise than by certain simple means the changes wrought on its system by the introduction of various parasites or poisons. The symptoms which are noticed by lay observers, when bees are suffering from any severe attack, are hastily assumed to be characteristic of "Isle of Wight disease," and the appearance of such symptoms in another colony is considered sufficient evidence that the same disease is present.

As a result of this misconception thousands of cases have been diagnosed as "Isle of Wight disease" merely because "crawling" or dysentery has been observed, while the dwindling of the colony or the death of the entire stock has often been accepted as conclusive proof without any trouble being taken to ascertain whether some other influence has been at work. If the honey-bee were a dangerous pest, the extirpation of which was desired by man for economic reasons, this unwarranted assumption might be of comparatively little importance, but in the case of a highly valuable insect, one of the very few which are of direct service to man, and which it is to his interest to keep alive, the error of thought leads to serious consequences. It appears to have led some scientific workers to the conclusion that *Nosema apis* is not the cause of any bee disease, just as it has led unscientific observers to the belief that "Isle of Wight disease" must be the cause of every case of extensive mortality in their apiaries, when no other obvious explanation is forthcoming. From every point of view, therefore, it is desirable that it should be universally recognised that bees are liable to many diseases, though their macroscropic symptoms are almost, if not entirely, identical, and that the only satisfactory definition of "Isle of Wight disease" is "the disease caused by *Nosema apis.*" Bee-keepers should also realise that the presence of this parasite can be determined, in our present state of knowledge, only by the examination of the affected organs of a bee under a microscope of high power. As it has been objected to this definition that certain bees of great resistant power may harbour *Nosema apis* in their intestines without apparent ill-effects on their system, a further definition is needed, and either it must be admitted that every bee in which the parasite is found is scientifically "diseased," or a distinction must be drawn between actual and potential disease, since it is believed that, in certain circumstances, even resistant parasite-carriers may suddenly, and without ascertainable cause, sicken and succumb to an attack.

The importance of this definition of "Isle of Wight disease" becomes clear when its bearing on scientific research into the treatment of bee diseases is considered. During the last six or seven years several remedies or preventives have been tried, and reports on the results of the experiments published in the journals devoted to bee culture. First it was a coal-tar preparation, then a compound of several well-known and powerful antiseptics, then peroxide of hydrogen, and at the present time "Flavine" is being widely recommended. Each of these remedies has had its vogue for a time, and the columns of the technical Press have been filled with enthusiastic testimonials from bee-keepers who have tried them with apparent success, only to be followed at a later date by letters from other bee-keepers who have completely failed to get any good results from their use. It is not suggested that any of these testimonials were other than genuine, but in view of what has been stated above it is at least regrettable that in no case that can be traced has the experimenter taken the trouble to ascertain by microscopical examination whether *Nosema apis* was present in the intestines of any of his bees, or, in other words, whether his colonies were really affected with "Isle of Wight disease" at all. The result of such treatment may be satisfactory to the owner of the bees, but it can have no bearing on its value in other equally undetermined cases of sickness.

The neglect to ascertain beforehand whether the causal organism of "Isle of Wight disease" is actually present when the experiment is begun must also invalidate the results in another way. So long as the parasite is present even in a more or less quiescent state, the affected bee is liable to an attack of "actual disease," and complete success cannot be claimed for any treatment unless it can be shown that after a considerable lapse of time the treated bees are free not only from the symptoms of sickness, but also from the parasites which may cause a fresh attack. In many cases statements as to the efficacy of this or that drug have been made within a few days, and even a few hours, of its application, though it is well known to all who have had any experience of bee diseases that bees respond very readily to a stimulus, and may under its influence reassume the appearance of perfect health for a time. The recovery, however, seldom lasts for long, and the influence of the stimulus declines progressively. Results should not, therefore, be published until after a delay of several weeks, during which time the bees should be carefully examined, and as the susceptibility of bees to "Isle of Wight disease" is greatest in the winter it would be better always to postpone judgment in every case until the spring, when the activity of the bees affords presumptive evidence of a cure. Nothing, however, but a careful microscopical examination of several specimens of the treated bees is sufficient to justify the confident statement that a cure has been effected.

Further investigation into "Isle of Wight disease" is urgently needed, but it should proceed on ascertained facts, and in the main should be devoted to the discovery of a method whereby the infection of the bee by the protozoon *Nosema apis* can be prevented or remedied, and the test of the success of any experiment to cure an affected colony must include, first, the determination of the presence of the causal organisms; secondly, the elimination of any other influence; and, finally, the proof of the freedom of the colony from the parasite after a considerable lapse of time.

THE DAMAGE TO AGRICULTURE BY VERMIN AND BIRDS.[1]

THAT farm vermin and certain wild birds annually commit an extraordinary amount of damage to agriculture and agricultural crops has long been recognised, and the need for more careful and systematic study of the subject has been frequently dwelt upon in these pages. The personal opinion held by "landowners, sportsmen, farmers, rat-catchers, and naturalists," as well as by a large class of bird-lovers, is really of very little moment. Anyone who has had to sift the evidence obtained from such sources knows how thoroughly untrustworthy and misleading it usually is. It is now universally recognised that a very definite and careful procedure is necessary, carried out by experienced and well-trained workers, if one wishes to arrive at a trustworthy and just conclusion respecting the economic status of any wild animal.

During part of 1916–17 an inquiry was undertaken upon this subject under the auspices of the Oxford School of Rural Economy in the counties of Oxfordshire and Norfolk. The method of inquiry will, we feel sure, strike every economic ornithologist, or, indeed, anyone versed in investigating the economic status of any wild animal, as peculiar, if not unscientific. The whole of the data here collected are practically obtained from local sources, viz. the opinions of "landowners, sportsmen, farmers, rat-catchers, and naturalists," and innumerable quotations from various newspapers. True, there are a few references to the writings of Tegetmeier, Gurney, and others, but the bulk of the work that has been done during the past twelve or fifteen years seems to have been ignored. Surely the conditions existing in the two above-mentioned counties do not differ so materially from those in all other counties as to make the results of such investigations superfluous to the farmers of Oxfordshire and Norfolk.

Dr. Gunther would, we feel certain, strongly deprecate such a method in any other biological inquiry. All investigators know how exceedingly difficult it is to arrive at a just conclusion with reference to the feeding habits of any particular species of wild bird and to be able to state definitely whether or not it is beneficial or injurious. To weigh the evidence rightly, long experience in such work is imperative, and whilst the author of this report has no doubt brought together much material that is interesting, it is not such as could be introduced into any scientific inquiry upon the subject, and it carries little, if any, conviction.

What this correspondent thinks or what that one has seen is really of very little importance, and, so far as the species of wild birds are concerned, only a prolonged inquiry, by an experienced investigator, upon the data obtained from numerous stomach and crop contents, as well as careful field observations, will ever prove of any practical service.

The only really valuable item in the whole report is that with reference to the pheasant, and, curiously, this is largely based on the careful investigations of a member of the Cambridge University School of Agriculture, Miss A. F. C.-H. Evershed. The much-maligned pheasant does not support existence upon a diet of mangels, in spite of weighty statements to the contrary. Miss Evershed and others have shown that unless excessive numbers of birds are kept upon a small area, it is distinctly beneficial to agriculture. Dr. Gunther directs attention to the fact that on some estates where many pheasants are reared there is an absence of wireworm, whereas on others where there are no pheasants wireworm is found in abundance.

In many cases the information given is exceedingly scrappy, *e.g.* in the case of the wild goose, the gull, the crow, the jackdaw, and the lark. As regards the author's conclusions, they do not materially differ from those that have been before the public for some years. We do not think that such reports as these are likely to enhance the reputation of the Oxford School of Rural Economy in the eyes either of the agriculturist or of the more restricted world of science; moreover, in our opinion, they are to be deprecated, as the work is based, not on "the solid ground of Nature," but on a loose and very heterogeneous mass of details obtained from sources not always trustworthy and free from prejudice.

Finally, if the report were intended for the instruction and benefit of farmers, surely a summary of the results obtained elsewhere, from exhaustive inquiries on large numbers of each species, during different months of the year and from various counties, should have been given.

WALTER E. COLLINGE.

[1] "Report on Agricultural Damage by Vermin and Birds in the Counties of Norfolk and Oxfordshire in 1916." By R. T. Gunther. Pp. 92. (Oxford University Press, 1917.) Price 2*s*. 6*d*. net.

NOTES.

FROM the *Scotsman* of March 13 we take this interesting illustration of the intervention of biological Providence in Scotland. "On a recent week-end there was a remarkable run of salmon in one of the Border rivers. The fish ascended the cauld in large numbers, and in the shallow water on either side it was a matter of no difficulty to seize some of them as they made the passage. The spectacle of so many fish passing to the upper waters led to a general relaxation of the ordinary conditions. On one of the days of the week-end, men, women, and boys could be seen in the water up to the knees and armed with gaffs. The operations of those actively engaged were watched by large crowds on the banks. The natural instinct for capture, aided by the food stringency, became so prevalent that an unprecedented spectacle was witnessed on the Sunday. Many who had been attending the morning service found the spectacle of one particular hole, which had practically become a moving mass of fish, too much for ordinary restraint." This is a sad decadence, but it was a miraculous draught of fishes! "The quantity of salmon taken at this point is understood to have been extraordinary. In the town in question, for the space of a week at least, there was no difficulty in keeping within the strictest meat rations. Two of the captured fish weighed 50 lb. and 48 lb. respectively." We have seen in peace-times this extraordinary miracle of fishes—a vivid illustration of the abundance and insurgence of life—and we can vouch, by analogy, for the accuracy of the *Scotsman* account, though "Dora," in her mysterious reticence, forbids us revealing the locus of the recent occurrence.

SOME articles on recent developments in marine lighting have appeared in the *Engineer*, and the article in the issue for March 15 gives an account of arrangements in unattended lightships and lighthouses, and unattended fog signals, all of which are features of recent practice. There are several methods of operating fog signals on beacons. It is now five years since an automatic acetylene fog gun was introduced by Messrs. Stevenson at Dhuheartach lighthouse. This gun is claimed to have great advantages over the ordinary tonite explosive signal. It is entirely automatic and fires as frequently as four times every minute, whereas the tonite apparatus can scarcely fire more often than once in five minutes, and requires constant attendance. Two acetylene fog guns have been installed on the Clyde at Roseneath Beacon and at Fort Matilda Pier, the operating station being at Gourock Pier. Wireless methods of operation are adopted. When fog appears, an aerial at Gourock transmits energy to aerials on the beacon and at Fort Matilda, thereby completing the circuits of the local batteries, and switches on the fog signals. Once set in action the guns work automatically, giving reports at predetermined intervals which can be heard over a distance of three miles in favourable weather. The guns are supplied with acetylene in measured quantities, the gas being mixed with the necessary proportion of air to produce a good explosive mixture. This application of wireless to other than telegraphic purposes is an important step in the field of marine lighting and signalling.

AT a recent meeting of the Royal Society of Arts, Prof. W. Frecheville read an interesting paper on the development of the mineral resources of the British Empire. He outlined briefly the main sources of production, and discussed more fully the measures that he considers necessary in order to increase the production of metals within the Empire. Like many other authorities, he is convinced that a Mineral Resources Bureau, properly constituted, might play a most important part in such development, and whilst fully admitting the great results attained in the past by our characteristic individualistic methods, he very properly raises the question whether we have not carried the practice of Government aloofness too far. Prof. Frecheville suggests that in Great Britain mining enterprise is hampered by the customary conditions of the mineral lease, inasmuch as this is often for a strictly limited term of years, and sometimes "royalties are exacted from mines which are not paying." He further touches on the injustice inflicted on mining ventures by the existing methods of levying income tax, a question which is at the present moment agitating many of those engaged in studying and fostering British mining industry. Prof. Frecheville rightly lays most stress of all upon the labour problem, and he suggests that "it should not be beyond the bounds of human ingenuity to devise some way by which, in conceding higher wages, more strenuous and intelligent labour should be obtained." This is beyond question the correct attitude towards labour, and if the Government Departments dealing with labour throughout the country had only pursued this policy instead of raising wages without demanding any increase of producing activity, the country would be in every way in a sounder position than it is in to-day.

WE regret to note that the *Engineer* for March 15 records the death of Mr. Greville Jones, who held the position of works manager at Port Clarence Iron and Steel Works for nearly twenty-five years. Mr. Jones, who was born in 1864, took a keen interest in the Cleveland Institution of Engineers, of which he was a past president, and read several papers before this body and also before the Iron and Steel Institute.

DR. ADDISON, Minister of Reconstruction, attended the Women's Liberal Federation Conference at Westminster on March 15, and spoke in support of a resolution (which was adopted) urging the Government to create a Ministry of Health. He said that the Government fully accepted the importance of establishing a Health Ministry as soon as possible. He thought that there was little doubt that very shortly the various authorities concerned would arrive at substantial agreement.

IN NATURE of January 31 mention was made of the suggestion by Mr. R. E. Dennett as to the desirability of a showroom in a London thoroughfare for exhibition of produce and photographs of West Africa, and it was added that further means of transport are required in that part of the globe. We are informed that the British West African Association, which organised the West African Section of the Coronation Exhibition, is establishing such an Exhibition Bureau in the City shortly, and will be glad of any loans or gifts from readers of NATURE interested in tropical Africa.

WE notice with regret the announcement of the death, in his seventy-seventh year, of Sir Swire Smith, M.P., who was well known as a strong advocate of technical education. From 1881–84 Sir Swire Smith was the representative of the woollen industries on the Royal Commission on Technical Education; in 1909 he acted as vice-chairman of the Royal Commission on International Exhibitions; and he was a member of the committee of the National Association for Technical Education, of which the late Duke of Devonshire was president.

THE issue of the *Comptes rendus* of the Paris Academy of Sciences for February 11 contains a note entitled "Observations sur le langage scientifique moderne," signed by twenty well-known French savants, including MM. Bigourdan, Bouvier, Guignard, Haller, Lacroix, and Emile Picard. This memorandum severely criticises the French of some recent scientific papers, and gives examples of badly constructed or unnecessary new words, of the incorrect use of recognised words and of new technical words left undefined, and of a too literal translation or adoption of foreign words. The examples chosen are mainly from papers on electricity, chemistry, biology, and bacteriology.

THE question of restrictions on coarse fresh-water fishes was discussed in the House of Lords on March 13. Lord Desborough proposed that the close season for angling for these fish should be shortened, and also that the restrictions on angling for eels should be removed at all times. It was announced that the Board of Agriculture and Fisheries had decided to reduce the close season for coarse fish by one month. Lord Buckmaster also referred to the general neglect of the culture of fresh-water fishes other than Salmonidæ. Little had been done in addition to the imposition of close times. The question of the destruction of fish by seagulls ought to be considered; steps should be taken to prevent pollution, as, for instance, that of fishing waters by tar from roads, and the whole question of the development of the fresh-water fisheries, from both the practical and the scientific viewpoints, ought to be considered in the interest of the food supply of the country.

AT the general meeting of the British Ornithologists' Union, held in the rooms of the Zoological Society of London, on March 13, Dr. W. Eagle Clarke, keeper of the Natural History Department of the Royal Scottish Museum, Edinburgh, was elected president in succession to Col. Wardlaw Ramsay. As a leading authority upon bird-life, Dr. Clarke's writings, especially upon migration, and his activities on the late British Association Committee on Bird Migration, and on the Government Departmental Committee of the Home Office at present having under revision the Wild Birds' Protection Acts, are well known. It is perhaps less well known that under his care the exhibited collection of British birds in the Royal Scottish Museum has become second to none in the kingdom, and that his forthcoming edition of Yarrell's "British Birds," which will make a special feature of immature plumages and of migration, promises to be one of the most comprehensive guides to the avifauna of the British Isles.

THE *Revue générale des Sciences* for February 15 contains an obituary notice by M. A. Boularic of Prof. G. Meslin, director of the Physical Institute of the University of Montpellier, who died on January 11. Prof. Meslin was born at Poitiers in 1862, and after studying at the Ecole Normale Supérieure became a secondary-school teacher. In 1890 he took his doctor's degree, and became lecturer at the University of Montpellier, and in 1904 director of the Physical Institute. His pleasant voice and his clear way of presenting his facts made his lectures fascinating both to his students and to the general public. His principal scientific work was optical; his paper on the reflection of light from the surfaces of thin metal films, and his modification of Billet's bi-lens experiment to produce semicircular fringes, are probably best known. He took charge of two solar eclipse expeditions, and proved that there is no elliptical polarisation in the light of the solar corona. Some of his most recent work was on magnetism, and his numerous results for the magnetic susceptibilities of para- and dia-magnetic metallic salts are of great value.

NEWS has just reached us of the death of Miss B. Lindsay, on December 16 last, at Onchan, Isle of Man, who may well rank as one of the women pioneers in morphological studies. Miss Lindsay's career as an investigator started with certain research work in connection with the embryology of the chick—work undertaken at the suggestion of Dr. H. F. Gadow. Later she compiled her "Text-book of Zoology," and afterwards two volumes in Newnes' "Useful Story Series," one on "Animal Life," the other on "The Microscope." Although rather inclined to abstract speculation, Miss Lindsay was yet very matter-of-fact, and methodical in her work. To put her work on the breastbone of birds upon a broader basis than the "everlasting chick," she collected numbers of seabirds' embryos at the Isle of Man, and a fine series of ostrich embryos. She was the first to show that ostriches are descended from birds possessed of the full power of flight. Her little text-book must have made many friends, because it is a sensibly, partly humorously, written introduction for those who take an interest in what have since become known as Nature-studies. It was while she was living at St. Andrews and working at the Gatty Marine Laboratory that Miss Lindsay had the opportunity of carrying out those investigations with regard to molluscs that she had long wished to conduct. Of her own time and labour she was generous in the largest degree, and she will be long remembered by those she lived amongst for her many thoughtful and kindly acts.

GEOLOGISTS who are interested in the unique collection of Silurian fossils in the Ludlow Museum will be glad to learn that the Ludlow Natural History Society has received a bequest of 200*l*. under the will of the late Mrs. Agnes Mary White. Mrs. White was the daughter of Mr. Humphry Salwey, one of the most active geologists in the Ludlow district during the middle of last century.

EGGS of an extinct ostrich are already known from the surface deposits of northern China. One specimen from Yao Kuan Chang, fifty miles south-west of Kalgan, was obtained by Harvard University in 1898, and another specimen from the banks of the Yellow River in Honan was acquired by the American Museum of Natural History last year. Mr. Harold M. Clark, of Wuan, Honan, now writes to the *North China Herald* that eggs of this kind are not uncommon in his neighbourhood, and are washed out of the river banks by floods. They seem to occur in the same manner as the eggs of Æpyornis on the shores of lakes in Madagascar. The Chinese eggs are about 7 in. in length, and thus scarcely larger than those of an average ostrich. No bones of the birds which laid the eggs have hitherto been noticed in the same deposits.

MR. J. REID MOIR has contributed to the Proceedings of the Suffolk Institute of Archæology (vol. xvi., part ii.) a valuable summary of our present knowledge of ancient flint implements in Suffolk. The paper is illustrated with a series of effective diagrams of typical implements of each successive period, and as nearly all stages are represented in Suffolk it becomes a useful work of reference of more than local interest. There may still be differences of opinion as to the rudely chipped flints which are ascribed to the handiwork of Pliocene man, but the arguments for their age and present interpretation are very clearly stated. We can only hope that before long Mr. Moir's persistent researches may be rewarded by the discovery of human remains of the same antiquity. In Suffolk, as in other western European localities, the finely worked Acheulean implements are certainly older than the less skilfully made chipped flakes of the Mousterian type.

SIR THOMAS HOLLAND, in his presidential address at the Chemists' Conference at Lahore, reported in the *Pioneer Mail* for January 18, laid down a far-reaching programme of research—the possibility of preparing in India chemicals used in textile and other industries; of other chemicals now imported but capable of local production; advice to firms and the undertaking of research for which their own staffs have not the time or facilities; preparation of supplies for medical services; systematic investigation of raw materials of probable economic value; and the publication of results when possible. This means the appointment of a large scientific staff, and there can be no doubt that as one result of the war and the obstruction of sea communications the Government of India will devote increased attention to the development of Indian manufactures.

THE *Pioneer Mail* of January 11 announces that much progress has been made in supplying the Indian hospitals with drugs and other materials from Indian sources. Absolute alcohol, previously imported from abroad, is now made at the Government depôts at Bombay and Lahore, and by private firms at Calcutta and Ahmedabad. Belladonna is being largely cultivated in Kumaun, and among other drugs now supplied from Indian sources are thymol, ether for pharmaceutical purposes, lysol, calcium chloride, lactose, and aniline oil, while arrangements are being made to provide in India all the various nux vomica preparations. Bandages and dressings are now being locally made, and glass is being manufactured for laboratory, medical, and surgical purposes. Artificial limbs of the latest pattern are being manufactured at Bombay. In short, the demands of the war in the domain of medicine and surgery are being met in India on a very considerable scale.

A REPORT of a bacteriological investigation of the City of Dublin milk supply is published by the Co-operative Reference Library, Dublin. Of more than 100 samples analysed, only seventeen could be considered satisfactory; all the others would be classed as low-grade milks unsuited for drinking in the natural state. The examinations were conducted by Mr. D. Houston, who gives a general discussion of the results obtained, and a preface is contributed by Dr. St. John Gogarthy on the importance of a pure milk supply.

THE extraction of quite a small metallic fragment from the brain is recorded in the *Archives of Radiology and Electrotherapy* for February (No. 211). The foreign body was localised by the X-rays, and the skull opened. The points of the forceps extractor were then introduced into the brain, and manipulated so that the shadows of the fragment and of the points of the extractor fell exactly in the middle of a small fluorescent screen attached to the instrument. After some manipulation the fragment was grasped and withdrawn. The blades of the extractor were connected with an electric bell, which rang when the fragment was grasped, the circuit being then completed. The fragment was about 2 in. below the surface of the brain, and the patient made a good recovery. Capt. Barclay was the radiographer and Capt. Rayner the surgeon in charge of the case.

ALTHOUGH the National Seed Testing Station has been in operation only since November last it is clear from the interim report on the quality of existing stocks of agricultural seeds, which is published in the February number of the *Journal of the Board of Agriculture*, that a great deal of useful work has already been accomplished. Up to February 4 tests had already been completed on more than 2400 samples, and although in certain species the numbers of samples are too small to be taken as representative of the stocks of these seeds in the country, it is thought that the figures given in the report may be taken as a fair index of the standard of the more important seeds. It is reassuring to find that good seed in moderate quantity is available in the case of the more important crops, especially the grain crops. At the same time, it is evident that there will be a large amount of low-grade seed offered to farmers this season. This is particularly so in the case of red clover, sainfoin, and meadow fescue, which would seem to be considerably below the average of normal seasons. In the case of cereals, attention is directed to the undesirability in the national interest of making large sowings of grain of low germination when good samples of high germination are obtainable, and permit of a much lower rate of sowing. The staff of the station is to be congratulated upon the large amount of work accomplished under conditions of exceptional difficulty.

A STRIKING object-lesson on the capabilities of water-power, when adapted to industrial and manufacturing uses, was afforded in an exhibition of kinematograph films by Prof. J. C. McLennan, at the Institution of Civil Engineers, on the evening of March 12. The films were prepared by the Water-Power Branch of the Department of the Interior of Canada, of which Mr. J. B. Challis is superintendent. The exhibition was given under the auspices of the Canadian Government, and was intended to demonstrate the wonderful extent of the hydraulic resources of Canada. In his introductory remarks Prof. McLennan alluded briefly to the progress of the country; thirty years ago it might have been described as steady to variable, but during the past twelve years it had undergone a remarkable acceleration, which was apparently destined to become even more accentuated in the immediate future. This was due, in a very large measure, to the construction of the three great highways across the Dominion—the Canadian Pacific, the Canadian Northern, and the Grank Trunk Railways. Arising out of these as primary agencies, a great impetus had been given to agriculture, education, and industry. The water resources of Canada were estimated at twenty million horse-power, as compared with twenty-eight million horse-power in the United States, and of these some two million horse-power were now in use. The importance of the conservation of such stores of energy was fully recognised, and impounding works were being carried out in order to realise the utmost capabilities of supply, as might be instanced by the reservoir dam at La Loutre, which impounds 160,000,000,000 cub. ft., and has an effective drainage area of 16,200 square miles. One of the most important uses to which water-power had been applied was the solution of the problem of the fixation of nitrogen from the atmosphere. The films illustrated a number of waterfalls, reservoirs, and installations of hydro-electric plants in various parts of the Dominion, including Grand Mere, Shawinigan Falls, Cedar Rapids, St. Timothee, Winnipeg, Vancouver, and Niagara.

PART 1 of vol. xxx. of the Proceedings of the Royal Society of Victoria contains a description of a new dividing engine for ruling diffraction gratings by Mr. J. H. Grayson, of the University of Melbourne. The design and construction of this machine have occupied Mr. Grayson, whose skill in work of this type is well known, for seven years, and the completion of the task places spectroscopists under a great debt of gratitude to him. His paper contains a detailed description of the machine, and gives full particulars of the methods used for grinding and testing the screw. The machine is set up in a room of its own in the basement of the University, and is driven by a 1/40-h.p. hot-air engine placed in an adjoining room. Ruling diamonds are broken stones in which the fracture along a cleavage plane intersects an outer crystalline face and gives a good knife edge. Mr. Grayson finds the stones from the diamondiferous drift of New South Wales best for this purpose, and when ruling properly such a diamond makes no noise. The photographs which accompany the paper show that the rulings are extremely regular and warrant the hope that gratings ruled on the machine will give exceptionally clear spectra. The verdict of spectroscopists on the gratings will be awaited with considerable interest. In the meantime all will congratulate Mr. Grayson on the completion of his work, and the University of Melbourne on the public-spirited way in which it has provided facilities for that work.

IN his presidential address to the section of the Indian Science Congress dealing with Physics and Mathematics, Dr. Wali Mohammad has given an interesting account of recent progress in magneto-optics.

He reviews the more important results obtained since the publication of Zeeman's monograph upon the subject in 1912. Amongst the improvements in technique have been the introduction of the Wehnelt cathode lamp devised by Dr. Mohammad himself, the use of crossed spectra from two pieces of apparatus of high resolving power, and the construction of more powerful electromagnets. Nagaoka and Takamine have taken up the study of the Zeeman effect in the ultra-violet region, whilst Croze has extended his observations into the infra-red so far as the photographic methods allow. The effect of a magnetic field on the satellites of complex lines is likely to give a clue as to the mechanism of radiation and the production of spectrum lines. The study of the magnetic resolution of band spectra has attracted much attention. There is now no doubt of the fact that some band spectra show the Zeeman effect, but opinion is divided as to the existence of the effect in other cases. Certain dissymmetries have been observed both in the place and in the position of components, and several complicated types of magnetic resolution have been noticed. Anomalies of a different kind have been found in which the lines of a very close doublet or triplet series appear to influence each other in a peculiar manner. On the theoretical side Voigt has modified and extended the theory of Lorentz, introducing into the equations terms expressing a resistance, a quasi-elastic force, and allowing for the coupling of the electrons. It is to be noted that when the quantum hypothesis, as represented by Bohr's equations, is assumed, there is no place left for the quasi-elastic oscillating electrons which have been used in all theories for the explanation of the Zeeman effect from Lorentz to Voigt.

Now that our rations of food, particularly of meat and wheaten bread, have been so appreciably reduced the necessity of arranging our diet so as to ensure a sufficient supply of those elusive substances, the so-called "vitamines," is more important than ever. It is known that these substances exist in certain foods, and that an adequate supply of them is necessary to health, but they have not yet been isolated in a pure condition, although several workers claim to have done so successfully. As a result of some recent work, McCollum and Davis concluded that two distinct types of vitamine exist, the "fat-soluble A" and the "water-soluble B." In the *Biochemical Journal* for December Mr. J. C. Drummond describes yet another attempt to isolate the latter type of accessory substance. Unfortunately the attempt failed, but several interesting observations were made. In Mr. Drummond's experiments pure-bred rats were fed on a basal artificial diet containing all the necessary constituents except the water-soluble, growth-promoting accessory substance, and also on the same diet together with marmite which had been treated in various ways. From the variation of the live weight of the rats the presence or absence of the "water-soluble B" in the treated marmite is inferred. In this way it is established that the water-soluble accessory substance is (1) soluble in 70 per cent. alcohol, but insoluble in absolute alcohol; (2) dialysable through parchment paper; (3) injured by heating at 120°, but very little affected at 100°; (4) largely destroyed by prolonged boiling with 20 per cent. sulphuric acid, but not with 1 per cent. hydrochloric acid; and (5) much damaged by digestion with hot 5 per cent. sodium hydroxide, but very little affected by the same solution cold. Water solutions containing the active substance give voluminous precipitates with phosphotungstic acid, basic lead acetate, and silver nitrate, but the solutions recovered from these precipitates by the customary methods have little activity. The author attributes this fact to loss of the substance by adsorption rather than to its actual destruction. The results support the view that the so-called "antineuritic vitamine" is identical with the "water-soluble B."

MR. F. EDWARDS, 83 High Street, Marylebone, has just published a catalogue (No. 381) of books on British and foreign birds. It contains some 642 titles. Some of the books are scarce. Two sets of the *Ibis* (1859–1915) are offered for sale.

MESSRS. GAUTHIER-VILLARS ET CIE (Paris) announce the following science books:—Œuvres de Henri Poincaré publiées sous les auspices du Ministère de l'Instruction publique par G. Darboux, tome i.; Œuvres de G. H. Halphen publiées par les soins de C. Jordan, H. Poincaré, E. Picard, avec la collaboration de E. Vessiot, quatre vols., tomes ii., iii., et iv.; Cours de Géométrie pure et appliquée de l'Ecole Polytechnique, Prof. M. d'Ocagne, tome ii., Cinématique appliquée, Stéréotomie, Statique graphique, Calcul graphique, Calcul grapho-mécanique, Nomographie.

OUR ASTRONOMICAL COLUMN.

THE PLANET MARS.—This planet came to opposition with the sun on the morning of March 15. On that date Mars was about sixty-one million miles distant from the earth, and had an apparent diameter of a little more than fourteen seconds of arc. The planet is now situated in Leo, on the eastern border, and moving to the W.N.W.

The present opposition of the planet is by no means a favourable one for the study of his surface markings. It is curious, however, that some excellent views of the markings have been obtained on occasions when the disc was comparatively small, and when little success in this direction was expected. The fact is that certain lineaments on Mars, such as the Syrtis Major, the Mare Sirenum, Cimmerium, and Acidalium, are so conspicuously dark and large that a very small telescope is sufficient to show them, and they may be viewed even when the conditions are not altogether favourable.

Perhaps the features on Mars are, however, scarcely so easily discerned as those on Jupiter, owing to the expansive disc of the latter object. But the study of Martian markings is more interesting from the fact that they represent objects existing on its actual surface, while Jovian details are merely temporary, outside formations of atmospheric character.

The double canals on Mars are now justly regarded as one of the observational romances of astronomy. The single canals have even been assailed as non-existent, but there is no question whatever that a series of linear formations is scattered over the equatorial and south-equatorial regions of the disc. Scepticism was aroused by the hard, dark, and straight lines by which some observers erroneously represented the delicate streaks of shading which really diversify the planet's surface, and certainly look nothing like water channels to an unimaginative observer.

It is to be hoped that the renewed study of the topography of Mars will be successfully made at this opposition, and the revised rotation period of 24h. 37m. 22·57s. tested by fresh data.

WOLF'S NOVA.—Besides the interesting planet found in January, Prof. Wolf also discovered a Nova in Monoceros. The Harvard plates have enabled its previous history to be traced. It was fainter than 9·8 mag. on December 22, rising to 5·4 by January 1 (being thus the brightest Nova since 1912). It declined rapidly, reaching mag. 8·9 on February 4, 9·0 on February 17, 9·1 on February 22. It is 10° north and 2° west of Sirius, and, like most Novæ, lies within the Galactic Zone.

Dr. Mundler gives the position for 1918·0 as R.A. 7h. 22m. 47·00s., S. declination 6° 30′ 34·7″.

A Potsdam spectrograph taken on February 18 shows the typical Nova-spectrum in the stage of decline; broad bright hydrogen bands on a somewhat faint continuous background that could be traced far into the ultra-violet; groups of lines were seen at λ 464, and a trace of the green nebula line.

THE MINOR PLANETS.—In 1866, when only eighty-eight asteroids were known, Prof. Kirkwood detected gaps in their distribution, at points corresponding with commensurability with Jupiter's motion. Prof. Hirayama (in Proc. Tokyo Math.-Phys. Soc., 2nd series, vol. ix., 11) re-examines the question with nearly 900 orbits available. The gaps at the ratios 2/1, 7/3, 5/2, 8/3, 3/1 are still very striking, and some others are probably indicated. Prof. Hirayama makes the interesting remark that for values of the daily motion smaller than 500″ the asteroids seek, instead of avoiding, the points of commensurability; thus the four Trojan planets have the ratio 1/1, one planet has 4/3, and six have 3/2. These cases are shown to correspond with librations of a stable character, while the gaps mentioned above correspond with unstable motion. It would probably have been better to omit all asteroids observed at one opposition only, as the elements of their orbits are subject to considerable uncertainty. The new planet DB (daily motion 881″) lies fairly close to the 3/1 point, so its perturbations by Jupiter will be interesting.

As the war has severed relations with the Berlin Rechen-Institut, formerly the centre for discussion and distribution of minor planet information, an independent bureau has been opened at Marseilles Observatory, whence numerous circulars relating to orbits and observations have been sent to us. One of the ephemerides is that of Deianira, which has been observed at only three oppositions since its discovery. Its position on March 22 is R.A. 12h. 19·3m., N. declination 18° 26′, magnitude 13·1.

THE ROTATION OF THE EARTH.

THE *Revue générale des Sciences* of January 30 contains a full abstract of a very interesting paper by D. Korda in *Archives des Sc. Phys. et Nat.* (Geneva) of November 15 last. It appears that Baron Eötvös, in examining the records of gravitation made at sea, found certain anomalies which he traced to the speed and course of the ship. The weight of a thing on the surface of the earth is less than that due to the attraction of the earth by an amount equal to the centrifugal force, which at the equator amounts to $g/288$, and which, resolved in a vertical direction, varies as the square of the cosine of the latitude. Any variation in the centrifugal force therefore affects the weight to this reduced extent. The velocity at the surface of the earth may be 46,500 cm./sec., while that of a ship in the water may be 1000 cm./sec., so that the motion of the ship round the axis of the earth may vary between 47,500 and 45,500 cm./sec. at the equator. Centrifugal force varies as the square of the velocity, so, calling V and v the velocities of the earth's surface and of the ship in the water, the centrifugal force on a body in the ship may vary between $(V-v)^2$ and $(V+v)^2$—that is, through a range of $4Vv$ depending on the course. While v may be relatively small, the large factor V may, and does, at times make the product so great as to introduce an error in the apparent gravity as determined on board ship. For example, in the case supposed, which corresponds with a speed of 19·4 knots and at the equator, the difference in weight as shown by a spring balance going east with the earth and west against the earth would be as much as 1/3355, or more than two grains per pound—quite a serious amount in a gravitational survey.

But it is here that the ingenuity, daring, and experimental skill so typical of Eötvös comes in. Not content with finding serious disturbances in weight resulting from velocities of 1000 cm./sec., he conceived the idea of setting up in the laboratory a small delicate balance on a rotating vertical axis with the accurately balanced masses moving at a speed of about 1 cm./sec., with the view of observing the disturbance of the balance. At the equator with such a speed the two masses would alternately seem the heavier by 1/3,355,000 of themselves, whereas at his laboratory at Budapest, which is very nearly at latitude 45°, the difference would be one-half of this—not a very large amount to play with—but Eötvös was able to make manifest the minute change by employing synchronism and the principle of resonance, and so obtaining the large magnification which is possible with a very small degree of damping.

Unfortunately, the published account is most tantalising; for beyond saying that the period employed was about a minute, that the maximum oscillation could be read in an hour, and that the balance was small, not one of the details which would assist in repeating the experiment is given—length of beam, load at each end, decrement, and stability are alike left undefined. The mode of observation, however, is described. A horizontal mirror is carried by the beam so that a vertical ray of light may be reflected up by it. When an experiment is to be made the beam is arrested and the reflected ray of light traces a small circle upon a screen. When the beam is liberated the two ends, alternately becoming the heavier, set up an increasing oscillation made evident by the departure from the original circle, which settles down to an amount determined by the equation:

$$\text{Maximum amplitude} = 2\Omega \cos \phi \frac{K}{k},$$

where Ω is the angular speed of the earth, ϕ the latitude, K the moment of inertia of the balance, and k its coefficient of damping. This formula quoted by the author is remarkable in that almost every feature of the apparatus and of the earth is eliminated.

The present writer, desiring to verify the formula, obtained a different result, and then, testing both formulæ dimensionally, found the formula at which he had arrived dimensionally correct, while that given above is not. He thinks, therefore, that it is desirable to state very shortly the facts as he understands them. The balance is supposed to be rotated accurately at the speed of true synchronism, taking into account the effect of centrifugal stability discussed in the next two paragraphs. In these conditions, treating the vibrations as the projection of a logarithmic spiral, and using the hodograph as given by Tait and explained more clearly in Clerk Maxwell's "Electricity and Magnetism," vol. ii. [731], the radius A of the spiral grows until the resistance proportional to the velocity is equal to the maximum deflecting moment due to the action of $4Vv$. The value of A, then, is the maximum value, and the spiral has become a circle. When this is reached the actual resistance couple will be found to be $\frac{8\pi AkK}{T^2}$, and this must be equal to the couple $\frac{8\pi K\Omega}{T}\cos^2\phi$, due to the $4Vv$ action described. From this it follows that

$$A = \Omega \cos^2 \phi \frac{T}{k},$$

where T is the time of a complete rotation of the balance and k is the logarithmic decrement. This A is the angular deviation from the mean position, so if by A is meant the complete amplitude, the expression must be multiplied by 2. It will be noticed that the difference is of serious importance. The cosine should be squared and the moment of inertia of the balance should be replaced by the time of its swing! A little thought will show that K must come in equally on both sides of the equation and so be eliminated. It is somewhat surprising to find T in the numerator, for this would seem to indicate that if the balance did not turn at all there would be—as measured by its tangent—an infinite deflection—*i.e.* 90°. Of course, the real meaning is that while the deflecting couple becomes less as T is greater, the sensibility becomes greater in the proportion of the square of the time, and the deflection goes on getting greater with increasing slowness of rotation until the whole thing becomes unmanageable on account of its too great delicacy, or until the decrement, by its consequent increase, more than compensates for the diminished stability. It is not clear what numerical results, if any, were obtained by Eötvös. By the formula now given, taking T as 60, K as 300 or thereabouts, and ϕ as 45°, the amplitude should only come out about one-seventh of the amount that the published formula would require.

It may be worth while to point out that the centrifugal force of the balance about its vertical axis, if the beam is 20 cm. long and turns once a minute, is about 720 times as great as the alteration of weight at the equator, so that if the beam were exactly in neutral equilibrium when stationary and pointing east and west it would have, in virtue of its rotation, a stability given to it under which the change in weight could not produce a steady deflection exceeding about 1/12°. No information is given as to how k was determined, nor is centrifugal stability mentioned. As in any system the logarithmic decrement becomes less as the stability is greater, it would be useless to determine k with any but the correct stability. The only method apparent to the present writer would be the addition of a stability bob equal in effect to the calculated centrifugal stability and a determination with the rotation stopped.

No mention is made of the most interesting feature in the scheme of the experiment. If the balance is in perfectly neutral equilibrium when not rotating, then the centrifugal stability is the only stability, and perfect synchronism is obtained whatever be the speed of rotation, whereas if there had been any initial stability or instability it could never be attained at any speed.

If the direction of rotation is such as to make the north end heavier than the south end, then with very small damping this end should be in nearly its highest, not in its lowest, position, as might at first be expected, at each turn.

This experiment, which, like those with the gyrostatic compass, and unlike Foucault's pendulum experiment, is best done in the tropics, is one of such interest and beauty that it is to be hoped, even in these difficult times, it may be set up and exhibited in some physical laboratory.

It is unfortunate that the author has not done justice to Eötvös, but he has prepared somewhat of a tangle which it has been a pleasure to unravel.

C. V. BOYS.

RESULTS OF VOLCANO STUDY IN HAWAII.

THE Hawaiian Observatory was founded in 1912 by the Massachusetts Institute of Technology, and financed in large measure by business men in Hawaii. Its publications have been systematic volcanologic and seismometric bulletins, and two larger reports, as well as numerous special articles. The scientific work has been done by Mr. T. A. Jaggar, director of the station, and Mr. H. O. Wood, associate. Preliminary announcement of results [1] at the end of the first five years of work reveals discoveries which may be of interest to science at large, and some of these discoveries are briefly reviewed here.

Nature of Hawaiian Gases and Flames.

The gas collected from a blowing-cone in the lava pit of Kilauea in 1912 by Day and Shepherd [2] contained dominantly sulphur dioxide, carbon dioxide, and nitrogen, subordinate amounts of the combustible gases, sulphur, carbon monoxide, and hydrogen, and only 4 per cent. of water vapour. The 79 per cent. of SO_2, CO_2, and H_2O could not, to the writer's thinking, be juvenile, but must in part result from union with atmospheric oxygen. Day had suggested that heat-producing reactions between such gases as free S, CO_2, and H, rising through the lava, would raise the surface temperatures so that the lava column might be at its hottest above instead of in the depths. Continuous recording and observation of flames, with experimental measurements of temperature and soundings of the lava for viscosity differences, show that this generalisation is well founded, and, in addition, that atmospheric oxygen is brought in contact with the magmatic gas so as to produce abundant flames of different colours. Air is sucked down at the convectional whirlpools and cascades. It is carried downward in the liquid lava lakes by foundering of porous crusts which cannot melt in the superfused lava glass. Air is also carried down in broken wall rock, in avalanches, and by burial of old talus. Lastly, with 33 per cent. volume shrinkage due to such gas reaction within the lava column as $2H_2+O_2=2H_2O$, even at high temperatures (1100° C. more or less), and with convectional gas pumping, a Bessemer furnace effect through the liquid lava may be created by indraught of air from the walls.

Of the three combustible gases H, CO, and S, sulphur is most in evidence as surface flames, carbon monoxide along with impurities may be represented by rare flames, while hydrogen probably flashes mostly to water-vapour in depth. There are whitish flames occasionally seen, and intensely hot bluish to violet flames play at all times from the glowing grottoes and chimneys. Some work has been done in an effort to photograph the flames with colour filters and panchromatic plates, and there is a promising field here for the study of flame spectra.

Nature of a Lava Column.

While it was known many years ago that some of the Hawaiian lava pools were shallow, few observers have imagined that the liquid lava rising 600 ft. during a year within a pit much deeper than that would be found by sounding at the end of the period to be only 45 ft. deep, though still fully liquid at the surface. This was the case at Halemaumau, the inner lava pit of Kilauea, in January, 1917 (Fig. 1). Sounding was accomplished by plunging a steel pipe into the lava lake at several different locations, and

[1] "The Outbreak of Mauna Loa, Hawaii, 1914," by T. A. Jaggar, *Amer. Journ. Sci.*, vol. xxxix., February, 1915, pp. 167–72. "Activity of Mauna Loa, December, 1914–January, 1915," by T. A. Jaggar, *Amer Journ. Sci.*, vol. xl., December, 1915, pp. 621–39. "Lava Flow from Mauna Loa, 1916," by T. A. Jaggar, *Amer. Journ. Sci.*, vol. xliii., April, 1917, pp. 255–88. "Seismic Prelude to the 1914 Eruption of Mauna Loa," by H. O. Wood, Bull. Seis. Soc. America, vol. v., No. 1, March, 1915, pp. 39–50. "Notes on the 1916 Eruption of Mauna Loa," by H. O. Wood. *Journ. of Geol.*, vol. xxv., Nos. 4 and 5, 1917, pp. 322–36 and 467–88. "Volcanologic Investigations at Kilauea," by T. A. Jaggar. *Amer. Journ. Sci.*, vol. xliv., September, 1917, pp. 161–220. "Live *Aa* Lava at Kilauea," by T. A. Jaggar, Journ. Wash. Acad. Sci., vol. vii., No. 9, May 4, 1917, pp. 241–43. "On the Terms Aphrolith and Dermolith," by T. A. Jaggar, Journ. Wash. Acad. Sci., vol. vii., No. 10, May 19, 1917, pp. 277–81. "Thermal Gradient of Kilauea Lava Lake," by T. A. Jaggar, Journ. Wash. Acad. Sci., vol. vii., No. 13, July 19, 1917, pp. 397–405. "On Cyclical Variations in Eruption at Kilauea," by H. O. Wood, Second Report Hawaiian Vol. Obs. (Cambridge, Mass., 1917).

[2] "Water and Volcanic Activity," by A. L. Day and E. S. Shepherd, Bull. Geol. Soc. Amer., vol. xxiv., 1913, pp. 573–606.

always the pasty bottom was found at fewer than 50 ft. of depth, with due allowance for the angle of immersion. This discovery, however, checked perfectly with the results of continued observation and survey which had repeatedly made record of shoals appearing in the lava, and of cascades from the liquid lake into marginal voids and over submerged ledges, after a period of subsidence. These hitherto unexplained facts at once became intelligible when it was realised that the lava column in reality is a semi-solid body filling the true crater from side to side, while the liquid lake is a gas-heated froth maintained through conduit holes honeycombing the upper part of the harder column. The basin of the lake is a shallow saucer, and convectional circulation keeps the liquid lava in motion. The famous islands and benches are of the bench magma, or semi-solid substance which forms the bottom of the liquid lake.

Thermal Gradient of Lava Lake.

With batteries of Seger cones encased in iron netting and strung on a wire, which in turn was placed within long steel pipes, measurement was made in 1917 of the thermal gradient (Fig. 2) of the liquid lava pool. Individual temperature measurements were also made of the fountaining grottoes at the margin of the lava and of flaming chimneys through blowing-cones above it. The highest temperatures, about 1350° C., were found in this air zone of free oxidation of gases; the fountaining lava reached a maximum of about 1180° C., the bright lines of the lake surface were at about 1000° C., while just below the surface the temperature was 100° lower. From here to the bottom of the lake 40 ft. down there was rising temperature. A thick lower stratum of the shallow lake showed uniform temperature between 1100° and 1200°. This lower stratum probably represents reheating due to oxidation of gas in contact with air carried down by foundering crusts. The fall in temperature towards the lake surface from the bottom up, which in the middle region amounts to 70° C. per metre, is due to surface radiation aided by gas expansion. The localised surface heating is due to surface oxygen and completion of reactions between rising unstable gas mixtures.

Dermolith and Aphrolith.

The writer has proposed these terms for fluidal lava and block lava respectively, called *pahoehoe* and *aa* by the Hawaiians, because, as the result of the investigations here recorded, he believes dermolithic *versus* aphrolithic process to represent respectively the liquefaction of lake magma and the gas expansion solidification of bench magma. The dermolithic basalts of Kilauea crater, characterised by wrinkled skins, have sufficiently adjusted and diminished their gas-bubble content to solidify from without inward. The aphro-

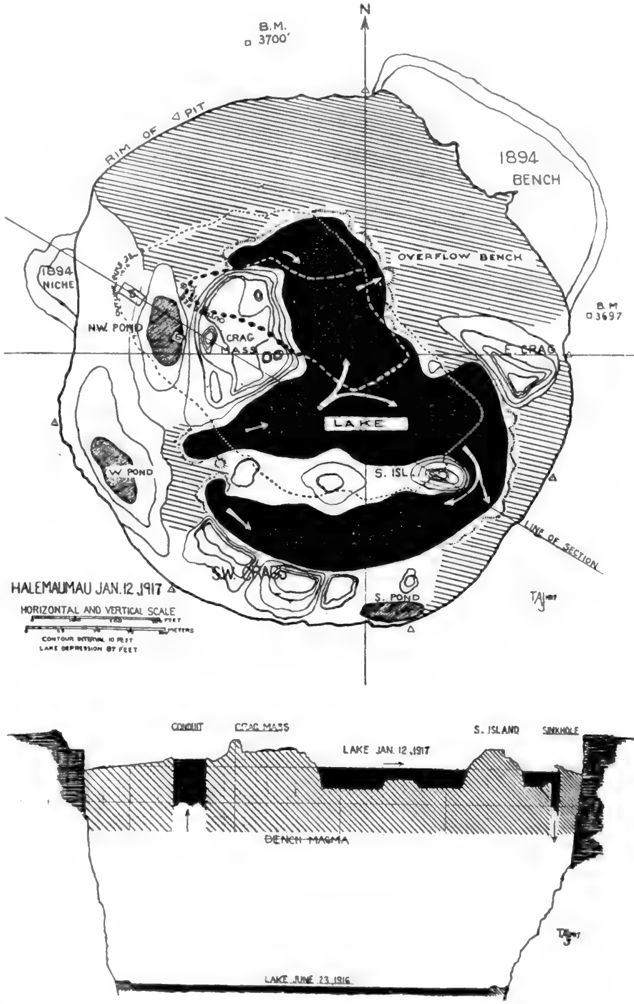


FIG. 1.—Map and diagrammatic section of Halemaumau, January 12, 1917. Lava lake in black, crusted conduit ponds shaded, overflow benches diagonal lines, raised crags contoured. Coarse dotted outline, lava lake of February 18, 1912. Fine dotted outline, June 23, 1916. Rectangle (5), site of lava spring of June 5, 1916. Rectangle (6), west corner of pool June 6, 1916. Note that N.W. corner has been conduit source on all these dates. Slight slope lake surface from conduits W. to overflow bench E. Bench magma elevated on conduit side W.S.W., subsided on sinkhole side E.N.E. Section without vertical exaggeration, lower profile shows simple rising pool of June 23, 1916. Shoal shown in lake bottom was revealed by subsidence February, 1917. Depths from soundings and subsidence records. Note progressive shoalings from W. to E. Diagrammatic sinkhole E. shows ridge of accretion on lake bottom margin which produces cascade ledge when subsidence takes place. Surveys with transit by T. A. Jaggar. Bench marks (B.M.) U.S. Geological Survey, trig stations Hawaiian Volcano Observatory. Meridian approximately 155° 17′ 8″ W., lat. 17° 24′ 33″ N. This is a typical survey of the kind made frequently at Halemaumau.—From *Amer. Journ. Sci.*, September, 1917.

lithic or *aa* lava, a "foam-stone," which is expelled in a Mauna Loa flow, cools from within outward by expanding gas suddenly released from solution, and the lava disintegrates into rough units. Lava drawn

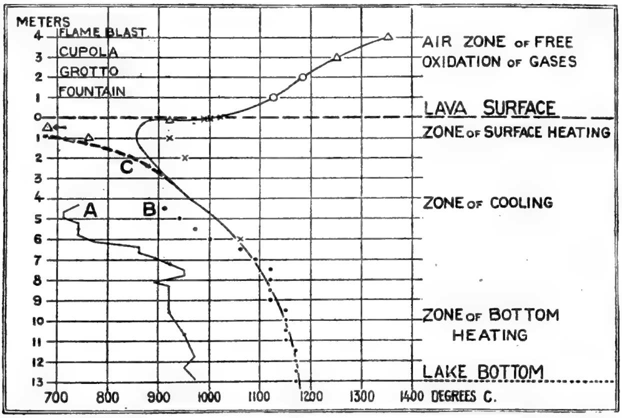


FIG. 2.—Thermal gradient of Kilauea lava lake, temperatures measured with Seger cones, 1917, by T. A. Jaggar. Triangles, circles, crosses, and dots each different series of measurements. A=actual uncorrected readings in large steel pipe. B=corrected gradient of lower lake. C=gradient to crusted lake surface when solidified.—From Journ. Wash. Acad. Sci., July 19, 1917.

up from deep within the Kilauea lake tended, on sudden cooling, to effloresce in aphrolithic fashion. An island which rapidly rose from the lake bottom proved to be typical *aa* or aphrolithic lava. The most satisfactory feature of the discovery that the Hawaiian lava column is probably stiff within the mountain is the correlation now possible with such volcanoes as Pelée, Bogoslof, or Tarumai, which exhibited hard domes and spines instead of lava flows. The liquid or dermolithic lavas now become products of surface fusion induced by escape of gases from solution in a very stiff intratelluric magma as solvent. A volcano like Kilauea, which among volcanoes exhibits maximum temperatures, probably owes the liquidity of its surface lava to the nature of its gas reactions.

Cyclical and Sympathetic Lava Movements.

A complete eruption of Mauna Loa, the summit crater of which is twenty-two miles from the Kilauea sink and about 10,000 ft. higher, consists of a preliminary summit outburst, followed, after months or a few years, by a flank discharge with lava flow. Recently the intervals between identical phases of complete eruptions have averaged something above nine years. Kilauea has shown no hydrostatic response to Mauna Loa lava, hence it was supposed they were unconnected. It will be clear, however, that if a main lava column depends for liquefaction on surface release of gas from a stiff silicate magma solution, hydrostatics plays only a superficial *rôle*, while varying viscosity, differential expansion, and tidal stress control relative heights of lava in adjacent and connected conduits of different sizes.

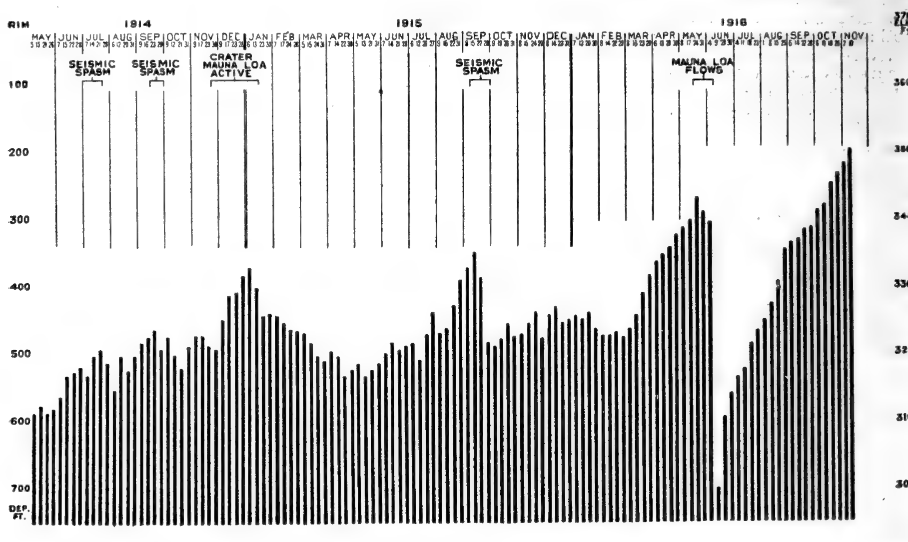


FIG. 3.—Diagram showing fluctuation of level of lava in Halemaumau, in relation to seismic and volcanic activities of Mauna Loa, 1914–16. Measurements from 120 weekly surveys by T. A. Jaggar shown.—Reprinted from *Amer. Journ. Sci.*, April, 1917.

During the complete eruptive period of Mauna Loa, 1914–16 (Fig. 3), five seismic spasms in that volcano, two of them accompanied by eruption, were responded to in the active lava pit of Kilauea by a series of pronounced risings of increasing duration, followed by sudden subsidences of increasing amount, as shown on the accompanying chart. The last and greatest subsidence of June 5, 1916, happened at Kilauea just at the close of the lava flow which culminated the eruptive period on Mauna Loa, and the lava column thereafter rose steadily for seven months on the Kilauea side of the system, the Mauna Loa side being sealed. There is good reason to suppose that similar sympathetic relations have existed in previous eruptions. There were no seismometric and volcanometric data on those occasions, and quantitative records are essential to establish such correspondences.

Another line of investigation, based on analysis of such lava-tide charts as Figs. 3 and 4, plotted for four and a half years, and on a study of the imperfect records from 1865 to 1911, indicates that there are larger semi-annual and smaller semi-monthly variations in the height of the lava column, after making due allowance for local interferences and longer term cycles, which vary strikingly with a time curve constructed to express the relative amounts of the forced nutational strains in the globe attributable respectively to sun and moon. Mr. H. O. Wood computed this curve, and the writer executed the lava measurements with alidade or transit for the years 1912, 1913 (Fig. 4), 1914, 1915, and 1916 (Fig. 3). It is possible that the longer term cycles vary with a strain curve of free nutation (Chandler) due to variation of latitude.

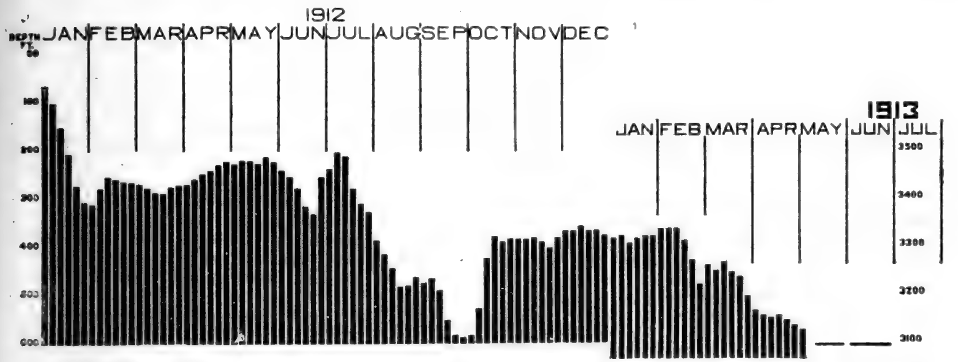


FIG. 4.—Chart showing measured rise and fall of Kilauea lava at five-day intervals during general subsidence 1911-13. Maxima near solstice, minima near equinox; supposed lunar fluctuation superposed upon this curve. Depths below rim of Halemaumau in feet (left), elevations above sea-level (right).

Seismic Indication of Volcanic Activity.

As stated above, there were earthquake swarms accompanying and preceding the outbreaks of Mauna Loa, and there have been similar groupings of local shocks accompanying the ups and downs of the Kilauea lava column. In addition, there are volcanic vibrations and extraordinary tiltings of the ground, the latter both periodic and prolonged, which promise intensely interesting data concerning the movements of the hard lava underground. Remembering the permanent surface deformation determined geodetically after the San Francisco earthquake, and after the eruptions at Usu and Sakurajima, in Japan, the writer believes, from experimental evidence, that a volcano station is most advantageously placed for critical seismometric investigation of the progress of such displacements. The co-ordination of deep magmatic movements with the earthquake problem is the profoundest enigma of geology. T. A. JAGGAR.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The School of Geography has published its programme of lectures and other work for next term. Mr. H. O. Beckit, the acting director, will lecture on the historical geography of Europe and on problems of social and political geography; he will conduct classes on elementary surveying and on Indian geography; also, in concert with the Rev. E. C. Spicer and Miss MacMunn respectively, a field class and a special class for the study of the Oxford district. Miss MacMunn will lecture on Indo-China, and Mr. J. Cossar on "Eastern Trade Routes." Informal instruction in geography will also be given.

The Committee for Anthropology announces lectures by Prof. A. Thomson (human anatomy), Miss Czaplicka (ethnology), Mr. H. O. Beckit (distribution of man), Mr. H. Balfour (comparative technology—æsthetic arts), Prof. Sollas (stages of human culture and the latest episodes in the earth's history), Mr. Griffith (questions relating to ancient Egypt), Dr. Marett (primitive morals, religion: rudimentary forms, legal institutions of savages), Mr. T. R. Glover (progress in religion), Dr. Farnell (Greek religion), Sir P. Vinogradoff (historical jurisprudence), Prof. Macdonell (Indian religion, customs, and archæology), Mr. V. A. Smith (Indian archæology and art), and Mr. S. Langdon (questions relating to ancient Babylonia). The instruction given in many of the foregoing subjects will be of an informal character.

LORD BRYCE and Prof. R. H. Chittenden, of Yale University, were the chief guests at a dinner of American University men now in England, including the graduates of the United States Military and Naval Academies, held under the auspices of the American Universities Alumni Association, at the Criterion Restaurant on March 14. The dinner marked the inauguration of a London branch of the American University Union in Europe. Lord Bryce, in the course of an address, said he cherishes the hope that after the war there will be more and more British students in American universities to learn those subjects which are best taught there, and more and more American students in British universities. The war has given convincing proof of the unity of spirit between England and America; and in the future the two nations will stand together to stop aggression and to guarantee to the world the peaceful development for which it is waiting.

THE Board of Education announces, in Circular 1034, that the following examinations have been recognised for the calendar years 1918 and 1919 as approved examinations, under the Board's scheme for the better organisation of examinations in secondary schools:—*As First Examinations:* (1) The School Certificate Examination of the Oxford and Cambridge Schools Examination Board; (2) the Senior Local Examination of the Oxford Delegacy for Local Examinations; (3) the Senior Local Examination of the Cambridge Local Examinations and Lectures Syndicate; (4) the School Certificate Examination of the University of Bristol; (5) the First School Certificate Examination of the University of Durham; (6) the General School Examination of the University of London; (7) the School Certificate Examination of the Northern Universities Joint Matriculation Board. *As Second Examinations:* (8) The Higher Certificate Examination of the Oxford and Cambridge Schools Examination Board; (9) the Higher School Certificate Examination of the Oxford Delegacy for Local Examinations; (10) the Higher School Certificate Examination of the Cambridge Local Examinations and Lectures Certificate; (11) the Higher School Certificate Examination of the University of Bristol (*a*); (12) the Higher Certificate Examination of the University of Durham; (13) the Higher School Certificate Examination of the University of London (*a*); (14) the Higher Certificate Examination of the Northern Universities Joint Matriculation Board. The examinations marked (*a*) will be held for the first time in 1919. The Board will pay to each school on the grant list an additional grant not exceeding 2*l.* on each pupil entered for any of the above-named examinations held during the years 1918 and 1919.

THE *Times Educational Supplement* (February 21) publishes an article entitled "The Universities and the War," which discusses the position of well-educated boys on attaining the age for military service, and suggests that the universities should be more fully used for the education and military training of young officers for the Army. It is pointed out that public-school boys who are members of the Officers Training Corps remain at school until attaining the age of eighteen and a half, when they are sent to officer cadet units for further training for commissions, whereas well-educated boys from all other secondary schools must enlist at about the age of eighteen, unless they go to a university and join an O.T.C. there. Those who enlist receive no special training for commissions for six months. The writer of the article therefore suggests that boys suitable for commissions should be encouraged by the War Office to join the universities and to receive military training in the O.T.C. Mr. Macpherson, in dealing with the question of the supply of officers in his statement in the House of Commons on February 20, admitted that invaluable work was done at the beginning of the war by the Officers Training Corps, but the War Office now expected a man to have served abroad before obtaining a commission, save in a few exceptional cases, and to have attained the rank of corporal, thereby having shown signs of leadership. For the Regular Army the period of training at Sandhurst and Woolwich had been extended. "It was not always the case that a boy who was able to pass with flying colours examinations in languages and mathematics made the best officer." The chances were that a boy who was captain of his school Rugby fifteen, who found it difficult to pass such an examination, had all the qualities of leadership, and should be given scope for the display of these qualities in the Regular Army. "The authorities at Woolwich considered the nominated candidates [those not entering by competitive examination] far and away the best, most capable, and hard-working, and they often produced the best officers." It appears extraordinary that, at this stage of the war, Mr. Macpherson should offer official encouragement to boys training for commissions not to apply themselves to their studies.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 7.—Sir J. J. Thomson, president, in the chair.—Prof. E. T. **Whittaker**: The numerical solution of integral equations. The present communication is concerned with integral equations of Abel's type

$$\int_0^x \phi(s)\mathrm{K}(x-s)ds = f(x),$$

and of Poisson's type,

$$\phi(x) + \int_0^x \phi(s)\mathrm{K}(x-s)ds = f(x),$$

where $\mathrm{K}(x)$ and $f(x)$ are given functions, and $\phi(x)$ is the unknown function which is to be determined. The object of the work is to obtain solutions of these equations in forms which can be made the basis of numerical calculation.—Prof. W. H. **Young**: (1) The Cesaro convergence of restricted Fourier series. (2) Non-harmonic trigonometrical series.—Prof. G. A. **Schott**: The electromagnetic inertia of the Lorentz electron. For a perfectly conducting oblate spheroid with speed kC, eccentricity k, and axis in the direction of motion, G. W. Walker (Roy. Soc. Proc., A 93, p. 448) finds

$$\text{Longitudinal electromagnetic mass} = \tfrac{2}{3}e^2a^{-1}\mathrm{C}^{-2}(1-\tfrac{1}{5}k^2)(1-k^2)^{-3/2},$$
$$\text{Transverse electromagnetic mass} = \tfrac{2}{3}e^2a^{-1}\mathrm{C}^{-2}(1+\tfrac{11}{60}k^2)(1-k^2)^{-1/2}.$$

Walker appears to regard this spheroid as a model of the Lorentz electron. If this be so, there is an obvious contradiction with the theory of relativity which demands investigation. The author has recalculated Walker's results on the basis of the general mass formulæ given in "Electromagnetic Radiation," Appendix D. The agreement between Walker's results and those of the paper, so far as it goes, indicates that his spheroid is not to be regarded as a model of the Lorentz electron.—Sir J. C. **Bose**: Researches on growth and movement in plants by means of the high magnification crescograph.

Linnean Society, February 21.—Sir David Prain, president, in the chair.—J. B. **Gatenby**: Notes on the bionomics, embryology, and anatomy of certain Hymenoptera Parasitica, with special reference to *Microgaster connexus,* Nees. The author remarked that *Microgaster connexus,* a parasite of *Porthesia similis,* was hyperparasitised by *Mesochorus pallidus.* The anatomy of Microgaster had been investigated; the larva has the posterior end of the body enlarged into the form of a spherical vesicle; the latter was thought by previous workers to be the ninth abdominal segment, but from anatomical and other evidence it is now considered to be the evaginated proctodæum. The embryonic membranes in Microgaster were also described, and notes were given on the various Hymenoptera parasitic on Aphidæ, and the embryonic membrane of an Aphidius was described. It was stated that internal entomophagous hymenopterous larvæ do not feed during practically the first third of their growth, but live by means of highly developed embryonic membranes; in their middle and later life they do not defecate; later larval and pupal stages were found to be generally normal.—W. B. **Brierley**: Experimental studies in the specific value of morphological characters in the fungi. In all systematic treatment of the fungi there is implied constancy of morphological characters, and particularly of the size and shape of the mature reproductive bodies or spores. An experimental study of the specificity of these criteria is in process, the work being carried out primarily upon the fungus *Botrytis cinerea.* This species is contained in the "Polyactis" group of the genus, and the species in this group are separated partly by reason of their different hosts, but more critically by minute differences in the branching and septation of the conidiophore and by the size and shape of the spore.

March 7.—Sir David Prain, president, in the chair.—Prof. E. B. **Poulton**: The mimetic and Mendelian relationships of the "White Admirals" of North America. The "White Admiral" butterflies of the Nymphaline genus Limenitis or Basilarchia (the North American subgenus) form an interesting group with peculiar larvæ and pupæ. Their conspicuous patterns are displayed in a floating flight, and the under surface of the wings is not procryptically coloured like that of the Vanessas—characteristics which are found in the specially protected models for mimicry, and the Müllerian mimics of other still more distasteful species; and so it is with Limenitis. The English *L. sibylla* is resembled by the female of the "Purple Emperor" (*Apatura iris*), which flies in the same woods, while the tropical American representatives of Limenitis—the powerful genus Adelpha—are beautifully mimicked by the females of the representatives of Apatura—the genus Chlorippe. The African representatives of Limenitis—the genus Pseudacræa—are almost all of them wonderful mimics of the Acræas, and in one instance of a Danaine

Zoological Society, March 5.—Dr. A. Smith Woodward, vice-president, in the chair.—R. I. **Pocock**: The external characters of the lemurs and Tarsius. The observations recorded were based, except in the case of Tarsius, upon specimens that had lived in the society's gardens. The author stated his opinion that Tarsius should be removed from the lemuroid primates and classified with the monkeys. He proposed to divide the primates into two primary groups, the Strepsirhini for the lemurs and the Haplorhini for Tarsius and the rest, the Haplorhini being further divided into the Tarsioidea for Tarsius and the Pithecoidea for monkeys, apes, and man.—Sir G. F. **Hampson**: Classification of the Hypsotropinæ. The author described the Hypsotropinæ as a rather obscure group of the Pyralidæ, of very uniform appearance and differing chiefly in structure.

Mathematical Society, March 14.—Prof. E. W. Hobson, vice-president, in the chair.—G. H. **Hardy**: The representation of a number as the sum of any number of squares.—G. N. **Watson**: A problem in the theory of numbers.—Prof. W. H. **Young**: Non-harmonic Fourier series.

PARIS.

Academy of Sciences, February 11.—M. Léon Guignard in the chair.—M. **Hamy**: A particular case of diffraction of circular stars and its application to the sun.—A. **Carnot**: New methods of estimation of copper, zinc, cadmium, nickel, and cobalt. The method is based on precipitation with sodium carbonate, solution of the precipitate in ammonia, and reprecipitation of the metallic hydroxide or carbonate by boiling.—M. Cuénot was elected a correspondant for the section of anatomy and zoology in succession to the late M. Maupas.—T. **Lalesco**: The classes of nuclei capable of symmetry.—E. **Léger**: The mechanism of the formation of certain isomers of cinchonine and their hydrohalides.—P. **Nicolardot** and J. **Boudet**: The examination of mercury fulminate and the analysis of mixtures for detonators. The methods suggested are based on treatment with yellow ammonium sulphide to form mercury sulphide, and precipitation of antimony sulphide from the solution by ammonium sulphite.—J. **Clarens**: The precipitation of phosphoric acid as ammonium phosphomolybdate. Practical estimation of phosphoric acid by a simple nitrometer measurement. A method is described for obtaining a phosphomolybdate precipitate in which the ratio of ammonia to phosphorus is fixed, so that the phosphorus is ultimately determined by a gasometric measurement.—L. **Dubreuil-Chambardel**: An anatomical variation of the second metacarpal.—E. **Roubaud**: Disappearance of the infective power in *Anopheles maculipennis* in the course of hibernation.—M. **Folley**: The cross of the aorta in exophthalmic goitre.

February 18.—M. Léon Guignard in the chair.—G. **Bigourdan**: Various French astronomical observatories of the seventeenth century.—M. Vayssière was elected a correspondant for the section of anatomy and zoology in succession to the late M. Renaut.—P. E. **Gau**: The integration of partial differential equations of the second order.—M. T. **Beritch**: The extension of Rolle's theorem to the case of several variables.—B. de **Fontviolant**: A new theory relating to the effects of the wind on bridges supported on arches.—M. **Maggini**: A new stellar photometer. A description of a modified wedge photometer.—A. **Véronnet**: The contraction of a gaseous mass and the evolution of the sun.—A. **Travers**: The estimation of vanadium in presence of molybdenum by titanous chloride.—L. **Gentil**, M. **Lugeon**, and L. **Joleaud**: Geology of the Sebou basin (Morocco).—L. **Dunoyer**: The diurnal variation of the wind in altitude and the influence of the distribution of the cloud masses.—M. **Reboul**: The diurnal variations of the wind in altitude.—L. **Daniel**: Extension of the limits of culture of the vine by means of certain hybrids.—L. **Lapicque** and J. **Chaussin**: The food value of whole wheat and of flour of 85 per cent. extraction compared with white flour. Medium wheat leaves 12 per cent. of indigestible residue; its nutritive value is equal to 90 per cent. of its weight of white flour.—P. **Brodin** and Fr. **Saint-Girons**: Contribution to the study of digestive leucocytosis.—H. **Colin**: Transformations of inulin in the tuber of the Jerusalem artichoke during the period of repose.—F. **Diénert** and A. **Guillerd**: The concentration of the micro-organisms of water. After trying and discarding various types of filters, and removal by formation of precipitates, a workable concentrating agent was found in alumina cream. Prepared and used in the manner laid down, from 80 per cent. to 100 per cent. of added *B. coli* were recovered.—A. **Bouquet** and L. **Nègre**: Culture of the parasite of epizootic lymphangitis and the experimental reproduction of the disease in the horse.—M. **Folley**: The aortic cross in exophthalmic goitre. Dilation of the aorta is a constant symptom of Basedow's disease, and may be used as a means of diagnosis in doubtful cases.—E. Le **Moignic** and J. **Gautrelet**: Intravenous injections of oil. Contribution to the physiological study of the T.A.B. lipo-vaccine. From 1 c.c. to 1·5 c.c. of oil can be safely injected into the circulation of a dog, and vaccines with an oil basis are proved to be less toxic than aqueous vaccines.

February 25.—M. Paul Painlevé in the chair.—G. **Bigourdan**: The old astronomical stations of Nantes and Pau. Historical notices of the work of Anastase, Fontenay, and Lévêque at Nantes, and of Richaud, Tawzin, Pallu, Graindorge, and Jean de Bonnécamp at Pau.—A. **Blondel**: The graphical determination of total inductances, direct and transversal, of alternators by means of the partial characteristics calculated or observed.—A. **Carnot**: Some new separations of the five metals of the group soluble in ammonia. Examples of the application of the method outlined in an earlier communication to the analysis of brass, German silver, and other alloys.—E. **Ariès**: The critical constants of mercury. The formula given in a previous paper, and worked out for the cases of argon, xenon, and crypton, is now applied to mercury, the vapour of which is also monatomic. The formula leads to 1077° C. for the critical temperature, and 420 atmospheres for the critical pressure of mercury.—W. **Kilian**: Contributions to the knowledge of the Delphino-Provençal and Rhodanian lower Cretaceous.—M. Flahault was elected a non-resident member in the place of the late M. Gosselet.—B. **Jekhowsky**: The generalisation of a theorem of Cauchy relating to developments in series.—R. de Montessus de **Ballore**: Skew quartics of the first species.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1917. Details of observations made on fifty-seven days.—E. **Vessiot**: Propagation by waves and the theory of general relativity.—P. **Weiss** and A. **Piccard**: A new magneto-thermal phenomenon. In the course of a magnetic study of nickel in the neighbourhood of the Curie point, the establishment of the field (15,000 g.) caused a marked rise of temperature (0·7°). The suppression of the field produced a cooling of the same order. The reversibility and order of magnitude distinguish this effect from heating due to hysteresis. Above the Curie point (629·6° Absolute) the rise of temperature is proportional to the square of the magnetisation, a result which can be deduced from the theory of the molecular field.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint-Genis-Laval) during the fourth quarter of 1917.—J. **Dufrénoy**: Tumours on the maritime pine.—C. **Cépède**: New method of staining the tubercle bacillus.—H. **Vincent**: The prophylaxy of Maltese fever by the active immunisation of the germ-carrying animals.

BOOKS RECEIVED.

Précis de Radiodiagnostic Technique et Chirurgie. By Dr. Jaugeas. Second edition. Pp. xxviii+563. (Paris: Masson et Cie.) 20 francs.

Localisation et Extraction des Projectiles. By L. Ombrédanne and R. Ledoux-Lebard. Second edition. Pp. iv+305. (Paris: Masson et Cie.) 4 francs.

Theory of Functions of a Complex Variable. By Prof. A. R. Forsyth. Third edition. Pp. xxiv+855. (Cambridge: At the University Press.) 30*s.* net.

The War and the Bagdad Railway. By Prof. M. Jastrow, jun. Pp. 160. (Philadelphia and London: J. B. Lippincott Co.) 6*s.* net.

Department of Commerce. U.S. Coast and Geodetic Survey. Terrestrial Magnetism. U.S. Magnetic Tables and Magnetic Charts for 1915. By D. L. Hazard. Pp. 256+illustrations in pocket. (Washington: Government Printing Office.)

The Advanced Montessori Method. By M. Montessori. ii., The Montessori Elementary Material. Translated by A. Livingston. Pp. xviii+455. (London: W. Heinemann.) 12*s.* 6*d.* net.

What Industry Owes to Chemical Science. By R. B. Pilcher. Pp. xiv+150. (London: Constable and Co., Ltd.) 3*s.* net.

The Systematic Treatment of Gonorrhœa. By N. P. L. Lumb. Pp. viii+116. (London: H. K. Lewis and Co., Ltd.) 4*s.* 6*d.* net.

Anti-Malaria Work in Macedonia among British Troops. By Dr. W. G. Willoughby and L. Cassidy. Pp. x+68. (London: H. K. Lewis and Co., Ltd.) 3*s.* 6*d.* net.

Tumours: Their Nature and Causation. By Dr. W. d'Este Emery. Pp. xx+146. (London: H. K. Lewis and Co., Ltd.) 5*s.* net.

Aids to Rational Therapeutics, with U.S.A. Pharmacopœia Equivalents. By Dr. R. W. Leftwich. Pp. x+233. (London: Baillière and Co.) 3*s.* 6*d.* net.

Aviation Engines: Design, Construction, Operation, and Repair. By First Lieut. V. W. Pagé. Pp. 589. (London: Crosby Lockwood and Son.) 15*s.* net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 21.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—The Mechanical Design and Specification of the Turbo-alternator Rotor: Dr. S. F. Barclay.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Annual General Meeting.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Problems of the Future in the Design and Construction of Merchant Ships: W. S. Abell.—Research in Marine Engineering: A. E. Seaton.—The Effect of the Longitudinal Motion of a Ship on its Statical Transverse Stability: G. S. Baker and Miss E. M. Keary.—At 3 p.m.—The Iron Carbon Equilibrium Diagram and its Practical Usefulness: Prof. H. C. H. Carpenter.—Stress Distribution in Bolts and Nuts: C. E. Stromeyer.

LINNEAN SOCIETY, at 5.—The Shoulder-girdle of a Dicynodont Reptile from South Africa: E. S. Goodrich.—Fossil Charas from Oligocene Beds: J. Groves.—Malayan Form of *Chlorococcum humicola* (Naeg.), Rabenh.: Miss B. Muriel Bristol.

FRIDAY, MARCH 22.

ROYAL INSTITUTION, at 5.30.—Radiation from System of Electrons: Sir J. J. Thomson.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—A Preliminary Survey of the Possibilities of Reinforced Concrete as a Material for Ship Construction: Major M. Denny.—Reinforced Concrete Vessels: W. Pollock.—Design and Construction of a Self-propelled Reinforced Concrete Seagoing Cargo Steamer building in Great Britain: T. G. O. Thurston.—An Investigation of the Shearing Force and Bending Moment acting on the Structure of a Ship including Dynamic Effects: A. M. Robb.—At 3 p.m.—Air Supply to Boiler Rooms: R. W. Allen.

PHYSICAL SOCIETY, at 5.—The Fourth Guthrie Lecture: The Origin of Spectra: Prof. J. C. McLennan.

SATURDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

MONDAY, MARCH 25.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Some Cottonseed Products in Relation to Present-day Needs: E. C. de Segundo.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, MARCH 28, 1918.

RECENT AMERICAN TEXT-BOOKS IN AGRICULTURE.

(1) *The Rural Teacher and his Work in Community Leadership, in School Administration, and in Mastery of the School Subjects.* By Harold W. Foght. Pp. xii+359. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 7s. 6d. net.

(2) *The Chemistry of Farm Practice.* By T. E. Keitt. (Wiley Technical Series.) Pp. xii+253. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6s. net.

(3) *Soil Biology: Laboratory Manual.* By Dr. A. L. Whiting. Pp. ix+143. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6s. net.

(4) *A Laboratory Manual in Farm Machinery.* By F. A. Wirt. Pp. xxii+162. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6s. net.

(5) *Late Cabbage from Seed until Harvest, also Seed Raising.* By E. N. Reed. Pp. xiii+131. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6s. net.

(1). OF recent years a great movement has been gathering force in the United States towards an improvement of country life. It is felt that rural civilisation should develop on its own lines, which would not necessarily be those followed by urban civilisation. The worker in the country is brought more into contact with things than with men: his environment differs fundamentally from that of the townsman, and his training and outlook on life must be modified accordingly. This movement found expression on the political side in Mr. Roosevelt's famous country life campaign, and on its educational side in Dr. L. H. Bailey's inspiring writings. If anything is to be done it must be through the teacher; Mr. Foght, therefore, in the first book on the list, addresses himself to the task of showing what part the school and the teacher ought to play, not only in training the children and the young people, but also in assuming leadership and direction in the new movement.

Mr. Foght points out that the present conditions of rural education in the United States are not entirely satisfactory. There are still too many cases where country teachers are engaged for a period of seven months only, at a salary of 75 dollars per month, who at the end of that time "pass from the community, leaving not the slightest feeling of regret behind." But the author—like the young American generally—is constructive in his mental attitude, and not a mere destructive critic. He proceeds to show what has been done, and then to indicate how existing institutions might be further developed. In his preface he puts the school aims as "(1) good scientific farming, rendering ample returns for labour and capital employed, and (2) a rural social life satisfactory to those living it." For our own part we should prefer to invert the order and adopt the view of Dr. Henry Wallace, quoted a few pages further on: "Give to any people a vision of something better than they have known, and it is at once a better occupation." In practice, however, the author is quite sound, as is evident from his handling of the subject. He proceeds first to discuss the agencies for the betterment of country life: the Church, the Y.M.C.A., the Grange of Patrons of Husbandry,[1] and the more recent organisations, Boy Scouts, Camp-fire Girls, Blue Birds, etc.

The next chapters give an account of certain schools started to improve rural life in general, and in particular to train the teacher. In the second part of the book the author goes on to consider problems of organisation and administration, for it is a fundamental part of his thesis that the teacher must be strong enough to establish himself as a leader of the community, and therefore must have a firm hold on the organisation and management of the school, and show expert ability in dealing with the altered school curriculum. The book is well provided with references to other literature, and illustrated with numerous charts and photographs. Altogether it gives an excellent account of what has already been accomplished.

(2) The connection between agriculture and chemistry is obvious to the man of experience, but not always to the young student, and one of the great difficulties at agricultural schools and colleges is to persuade the student that he cannot make much progress with the science of agriculture until he has a working acquaintance with the fundamental laws of chemistry. In the matter of text-books the American teacher is better off than we are, and this book by Prof. Keitt is a useful addition to the available literature. The laws of chemistry can quite well be taught through the medium of substances familiar on the farm, and experience shows that, when approached in this way, the subject is of great interest and value to the student.

It is unfortunate that efforts in the past to simplify chemistry and to bring it within the comprehension of untrained agricultural audiences have resulted in much looseness of expression. Thus when a farmer applies potassium salts to the soil as fertiliser, he is told that he is applying "potash," and a student is told that he is applying "potassium." This is justified on the score that the farmer and the student are supposed to understand the terms. Then, when the study of pure chemistry begins, the inevitable confusion arises. Anyone who has had to conduct agricultural chem-

[1] A sort of secret society or freemasonry, founded by Kelley in 1867, which reached its high-water mark in 1875; it is described in Buck's "Granger Movement," one of the classical "Harvard Historical Studies," and in Kelley's own words in his interesting "History of the Patrons of Husbandry."

istry examinations knows how completely an otherwise intelligent student can confound free and combined nitrogen, free and combined potassium, etc. We should like to have seen this distinction more strongly emphasised even at the risk of repetition. Thus on p. 39 the passages occur: "Phosphorus has an important part to play in the formation of the seeds of plants and in hastening their maturity. . . . Phosphorus appears luminous in the dark. . . . Potassium is rather abundant in Nature."

For the rest, however, the book will be found helpful. The numerous illustrations are largely taken from bulletins of the various experimental stations, and as the numbers are given they serve not only to emphasise the various points, but also as a guide to the voluminous and growing literature of the subject.

(3) Dr. Whiting's little book is a useful summary of laboratory methods for students wishing to become acquainted with the commoner soil micro-organisms. Methods are given for isolating and studying the common bacteria, algæ and protozoa, from soils, and references are given to original papers where the literature is more fully discussed. We note that Martin and Lewin's method for collecting active protozoa from soil is found to give good results with careful manipulation in the author's laboratory, just as it does in this country; for purposes of enumeration, however, the blood-corpuscle counting apparatus is used by Dr. Whiting instead of the dilution method in favour here. Exercises are also given on soil algæ, which have not yet received the attention they appear to deserve. For a long time the student has been able to obtain help in soil bacteriology, but he has found more difficulty in getting assistance with other organisms, and this little book can be recommended to him.

(4) In the past, farm machinery has been used to cheapen agricultural production rather than to intensify it, and so it has found greater development in new countries where labour is scarce than in older countries where higher yields per acre are aimed at. But in the nature of the case much of the machinery that has been purchased has not been properly used. It is not only the untrained amateurs who know so little about machinery; the trained agricultural student also is not uncommonly helpless before a trivial breakdown. On farms it is essential that someone should know sufficient about machinery to be able to look after it properly, to see that it is used to the fullest advantage, and to attend to the minor troubles, which, if left alone, might develop and cause serious difficulty at a critical time. This being so, it is gratifying to find that attention is being given by teachers and writers to farm machinery, and that some of the past neglect is being remedied.

Mr. Wirt's book will probably prove more useful to his own classes than to other teachers. It consists largely of questions that the intelligent student might be asked, and would, indeed, be likely to ask himself, but it does not provide the material for answers. It supplies, however, a bibliography which will serve as a guide to other books where more information is given.

If later editions are called for we should suggest the inclusion of more working diagrams illustrative of the main principles of the machine, the right and wrong adjustments, and especially the ways in which the machine may go wrong.

(5) Mr. Reed's little book on late cabbage is intended for practical men, and it is written in the terse American colloquial style that always appeals to practical men everywhere. The details of cultivation, manuring, insect pests, etc., are sufficiently clear to afford the necessary guidance. The author states with engaging frankness that he grows not only cabbage, but also seed, and he quite rightly emphasises the need for obtaining good seed; he does not unduly push his wares, however, and his book loses nothing in consequence. It is interesting in connection with our present conditions to note that in the author's experience cabbage does well on newly ploughed-up grassland, forming good hearts and needing no nitrogenous fertiliser. On older arable land more fertiliser is required, but not an excessive amount.

The author keeps rigidly to his title and does not touch on other members of the cabbage tribe, not even the nearly related early cabbage. He shows also that the native-raised seed is fully as good as the imported seed; on his own land he declares that in the past seven years he has not had less than 20 tons of cabbage per acre, whilst on at least one occasion he has had 30 tons. It is a good idea, which might be further extended, to persuade practical men to write little books on crops which they thoroughly understand.

E. J. Russell.

ESSENCES AND VARNISHES.

(1) *Manual for the Essence Industry.* By Erich Walter. Pp. iii+427. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 18*s.* 6*d.* net.

(2) *The Industrial and Artistic Technology of Paint and Varnish.* By Alvah H. Sabin. Pp. x+473. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 16*s.* 6*d.* net.

(1) THE phrase "essence industry" in the title of this volume covers more than an English reader might at first sight associate with it. In point of fact, the book is a treatise upon the manufacture of most of the things, or ingredients of things, which are intentionally flavoured, coloured, or perfumed, as a means of preparing them for human use. These include non-alcoholic beverages, such as lemonade and other "mineral" waters; alcoholic preparations like liqueurs, cordials, and bitters; flavourings and spices used in baking, cooking, and confectionery-

making; and essences used for the manufacture of perfumes, dentifrices, and other toilet articles.

Most of the flavouring substances employed in our beverages and foodstuffs are derived from plants, in which they usually exist ready-formed. The art of the essence-maker consists in transferring these flavours from the plant to a medium by which they can be readily conveyed to the potable or edible final product. The transfer may be a simple mechanical one, as when fruit juices are added directly to beverages. On the other hand, the essential principle of the flavouring substance may first have to be separated from the plant, as when the volatile aromatic oils (*e.g.* peppermint) are distilled off in a current of steam. These distilled oils may then be employed directly as flavouring agents, but, as a rule, they are more conveniently first dissolved in alcohol. Such solutions form one kind of "essence." Most fruit flavours, however, are too delicate for isolation in this way, and are obtained by distilling the fruit itself with alcohol, yielding another kind of essence. "Every fruit essence is only a diluted transfer of the volatile flavour of the fruits to alcohol." The same remark holds good for the floral odours which go to make perfumery.

The book under notice treats of the various ways in which this transference of flavours and odours from source to product is best effected. It opens with a dissertation on the sense of taste; this would be improved in parts if specific examples were given to illustrate the author's meaning. The following chapters deal clearly and concisely with the principles and practice of the industry. Fundamentally it is a "chemical" industry; hence a section of the book is rightly devoted to the laboratory. The theoretical chemistry of the products is not dealt with; but analytical methods and the general chemical control of the manufacturing operations make up a useful chapter.

A very large number of formulæ are supplied, and the systematic arrangement of these is a commendable feature. The British reader will need to bear in mind that the values of the alcoholic strengths and of the gallon used are those current in the United States; with this proviso, he will find the work a very useful one for the industry in question.

(2) Readers who are acquainted with the first edition of Mr. Sabin's work will remember that the author is an enthusiast on all matters pertaining to paints and varnishes. His book, consequently, has the quality of readableness usually found in the work of one who knows his subject and writes as if he loves it, even though that subject may not at first sight appear a particularly attractive one. Naturally, this quality is shown more especially in the historical portions of the book, but it is by no means absent from the more technical chapters.

For example, Mr. Sabin is discussing the varnish on Egyptian mummy-cases, and arguing for the antiquity of recipes substantially like some in use at the present day. "Here is the varnish, just as it was applied twenty-five hundred years ago. It is just as real as the mummy itself, and is just as absolute a proof that varnish was made in those days as the mummy is proof that people lived in those days. Here, I say, is the actual and real varnish. It was made with resin and oil. It was smeared on, possibly with a spatula, but more likely with the fingers, certainly not put on with a brush. Such a varnish as Theophilus describes would look as that looks, and in all probability would last as that has endured."

It is some twelve years since the first edition was published. The most important change in varnish-making during that period has been the introduction of tung oil, a product which has a remarkable power of rapid drying. The author believes, however, that the tung-oil varnishes are by no means so durable as the former oleo-resin products which they have so largely displaced. He notes that the general appearance of furniture and railway and other carriages has grown worse rather than better (in America) during the last ten years.

The author has some interesting remarks to make about violin varnish. He does not believe that spirit varnishes were ever used by the great violin-makers. Old violins appear always to have been coated with an oil-resin varnish. One valuable old instrument which he examined had a varnish which he concluded must have been made with at least 35 gallons of oil to 100 lb. of resin. If he were called upon to make a special varnish for violins, it would be, he says, a simple amber varnish with 35 or 40 gallons of raw linseed oil (to 100 lb. of amber).

Mr. Sabin writes from the American point of view, and disclaims any special knowledge of English practice; but his general outline of the principles involved in paint and varnish technology, and many of the applications of those principles which he describes, will hold good on both sides of the Atlantic.

C. S.

OUR BOOKSHELF.

Hand Grenades: A Handbook on Rifle and Hand Grenades. Compiled and illustrated by Major Graham M. Ainslie. Pp. v+59. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6*s*. net.

THE introduction states that hand grenades were in use until about the end of the seventeenth century, when they fell into disuse. It has been stated that they were used by the defenders of Mafeking. In the Russo-Japanese War they were employed, and became important weapons in the present war, where "it was proved that under many conditions infantry armed only with rifle and bayonet found it impossible to press home an attack or hold a position against troops armed with grenades." This little book is the result of experience in the present war.

Following the "brief summary of the various grenades, with instructions for preparing and firing," compiled in "drill book" style, but illustrated with most excellent diagrams, which are almost self-explanatory, is a section on grenade tactics. A description of French and German grenades follows, and then a section on explosives used in grenades. Here the author might well have been more explicit; in an attempt to be concise much of the information has been too condensed to be clear. We read, for example: "Picric acid. A yellow crystalline prepared from coal tar. A by-product of gas manufacture." Again: "Lyddite or picric acid. Consists of melted and solidified picric acid. Vaseline is used to melt it." The alternative for benzol is given as benzine. Under cordite no reference is made to M.D., but only to the old Mark I., and the nitroglycerine content of this is wrongly stated. The acetone used for incorporation is described as merely "acetone to harden."

The practical part of the book will no doubt be of assistance to students of grenade work; it is essentially a soldier's book, but its value would have been greater had the author not attempted to impart information in too few words.

Therapeutic Immunisation: Theory and Practice. By Dr. W. M. Crofton. Pp. 224. (London: J. and A. Churchill, 1918.) Price 7*s*. 6*d*. net.

IN the earlier chapters of this book the author surveys the processes underlying immunity, and describes the preparation and properties of toxins and antitoxins and the agglutination and precipitin reactions. The principles of therapeutic immunisation by means of vaccines are then considered, and finally the practical applications of therapeutic immunisation to diseases of the alimentary canal, the respiratory system, and other regions of the body are described. The author's system does not appear to differ essentially from the customary routine, with the exception that in some instances he advocates the continuance of treatment until very large doses of vaccine are reached, *e.g.* 30,000 million cocci in the case of some staphylococcic infections. The use of various iodine preparations is also recommended as an adjunct to vaccine treatment in some infections. For the treatment of tuberculosis, tuberculins made by extraction with benzoyl chloride, which is a solvent for the waxy constituent of the tubercle bacillus, are considered to be superior to the ordinary tuberculins.

In addition to vaccine *treatment*, the use of vaccines for *prevention* is also considered where they are applicable, as in the cases of typhoid fever, cholera, plague, etc.

The book gives a useful summary of the practice of vaccine treatment. The practical details of the isolation of the micro-organisms concerned and the preparation of the vaccines therefrom are, however, scarcely touched upon. Full directions are given for the dosage of vaccines and for the proper spacing of the doses, and these will be found very useful by the practitioner who is adopting vaccine treatment. 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.*]

The Stimulation of Plant-growth by Electric Fields.

IN his letter on the above subject in NATURE of March 7 "J. L." states that "the procedure suggests that it is the field of force that is expected to produce the stimulation. The comparatively trifling amount of electricity that leaks from the wires into the atmosphere could scarcely produce directly any sensible effect." It is perfectly clear, however, that Lemström—the professor of physics at Helsingfors who started about thirty years ago the modern phase of electro-culture with overhead wires—held the view that the current leaking from the wires and passing through the plant was responsible for the effects on plant growth which he describes. For the purpose of increasing the discharge he used fine wires, 0·6 mm. in diameter, placed only 40 cm. above the plants, and provided with "barbs" 2 cm. long. In similar experiments in this country the fine wires have been retained, though the "barbs" are usually dispensed with.

It is true that our knowledge of the effects of electricity on plant growth is practically *nil*, and that the currents in question are very small, being of the order of 1 milliamp. per acre in some recent experiments with wires about 7 ft. high. It is, however, not unplausible to assume, although, of course, there are other possibilities, that the passage through the plant of such minute currents may alter the rate of some of its metabolic processes, and so affect plant growth.

In the experiment suggested by "J. L.," where the overhead wire is supposed to be protected from leakage, as, for example, by encasing it in a solid dielectric, it is not clear that a discharge from the pointed aerial portions of the plant would continue unaltered. Although a strong wind may prevent a large part of this discharge from passing to the dielectric enclosing the wire, such a wind will scarcely be able to prevent other atmospheric ions from being attracted to its outer surface. Air currents, in fact, will bring such ions to the dielectric on which they will form a gradually increasing charge tending to weaken the electric field between the wire and the crop. If the overhead wire be bare, but of large gauge so that leakage from it is small, and its potential be increased to such a value that a discharge occurs from the plants, then, with a strong wind, the current passing through the crop may be very much greater than that leaking from the wires.

V. H. B.
G. W. O. H.

Does the Indigenous Australian Fauna Belong to the Tertiary?

THE statement that the indigenous mammalian fauna of Australia belongs to the Mesozoic has been so frequently made that it has come to be generally accepted. It was, therefore, not surprising to find the reviewer of Cleland's "Geology," in NATURE of August 2, 1917 (vol. xcix., p. 441), pointing out as a mistake the opinion expressed in that text-book that the fauna is a Tertiary one.

In order to ascertain the opinion of vertebrate palæontologists on this point, letters were sent to Messrs. J. W. Gidley, W. D. Matthew, and S. W. Williston.

All agree that the indigenous Australian mammalian fauna should be considered a Tertiary one.

"The Mesozoic marsupials were probably exceedingly generalised or primitive in type throughout their whole structure, whereas the numerous widely diversified forms of present-day Australian marsupials show a high degree of structural specialisation which can only be considered modern in character. The fauna of the early Tertiary, so far as we know it from the very imperfect fossil records, contains relatively few marsupials, and there seems to be as marked differences between these and their living relatives as between placentals of that time and their living relatives. Morphologically, therefore, I should consider the Australian fauna quite modern." (J. W. Gidley.)

Dr. W. D. Matthew states that "the amount of diversity among Eocene mammals is not greater than the amount among modern marsupials," and thinks "one can fairly say that the amount of adaptive specialisation among modern marsupials compares fairly well with that of Eocene placentals." Moreover, the brain development and teeth afford other evidence. The brains of Eocene mammals are fairly comparable with those of Australian marsupials, and the teeth have about the same stage of molar specialisation as Eocene placentals. The predaceous marsupials of Australia are also still in the Eocene stage, such as is seen in the Eocene Creodonts. The skeletal adaptations of the Australian fauna are comparable with the more primitive Eocene and Oligocene specialisations.

The continent of Australia seems to have been isolated either before the placentals reached that continent, or, possibly, some predaceous marsupial destroyed the early arrivals. The evidence points to the Basal Eocene as the time during which occurred the submergence which separated Australia from the other continents of the world.

H. F. CLELAND.

Williams College, Department of Geology,
Williamstown, Mass., February 15.

THE BOMBARDMENT OF PARIS BY LONG-RANGE GUNS.

IN the language of sport, the German gunner has "wiped the eye" of our artillery science and defied all the timid preconceived notions of our old-fashioned traditions. The Jubilee long-range artillery experiments of thirty years ago were considered the *ne plus ultra* of our authorities, and we were stopped at that, as they were declared of no military value. To-day we have the arrears to make up of those years of delay. But the German watched our experiments with great interest, resumed them where we had left off, and carried the idea forward until it has culminated to-day in his latest achievement in artillery of a gun to fire 75 miles and bombard Paris from the frontier.

From a measurement of the fragments of a shell a calibre is inferred of 240 mm., practically the same as the 9·2 in. of our Jubilee gun, which, firing a shell weighing 380 lb. at elevation 40°, with muzzle velocity nearly 2400 ft. per sec., gave a range of 22,000 yards—say, 12 miles. This was much greater than generally anticipated, but in close agreement with the previous calculations of Lieut. Wolley Dod, R.A., who had allowed carefully for the tenuity of the air while the shot was flying for the most part 2 or 3 miles high.

The German shell is likely to be made much heavier and very nearly a solid shot, better by its weight to overcome air resistance, the chief factor to be considered in the problem of the trajectory. If it was not for this air resistance a range of 75 miles with 45° elevation could be reached, on the old parabolic theory of Galileo, with so moderate a velocity as $V=\sqrt{(gR)}=3200$ ft. per sec., with $g=32{\cdot}2$, $R=75\times5280$; in a time of flight of about $2\frac{1}{2}$ mins., an average speed over the ground of 30 miles per min.

A velocity of 3200 ft. per sec. was obtained by Sir Andrew Noble in his experiments at Newcastle about twenty years ago with a 6-in. 100-calibre gun, with a charge of $27\frac{1}{2}$ lb. of cordite and a shot of unspecified weight, so it may have been the usual 100 lb. or perhaps an aluminium shot of half the weight.

Double velocity is usually assumed to carry twice as far; at this rate the velocity of our gun would require to be raised from 2400 ft. to about 6000 ft. per sec. to increase the range from 12 to 75 miles; such a high velocity must be ruled out as unattainable with the material at our disposal.

But in this range of 75 miles the German shot would reach a height of more than 18 miles and would be travelling for the most part in air so thin as to be practically a vacuum, and little resistance would be experienced.

So it is possible a much lower velocity has been found ample, with the gun elevated more than 45°, for the shot to clear quickly the dense ground strata of the atmosphere. Even with the 3200 ft. per sec. velocity obtained by Sir Andrew Noble a surprising increase in range can be expected over the 12-mile Jubilee range when this extra allowance of tenuity is taken into account, and a range of 60 miles be almost attainable.

A committee should be formed at once, composed of the artillery experts available, theoretical and practical, to make a start to recover our lost ground. If these long-range guns are now mounted afloat our Fleet is outclassed and cannot return their fire. A start could be made with no delay on one of our present 9-in. guns, strengthening the breech with wire coil and lengthening it with a chase of tubes screwed together, as in the Noble experimental 6-in. gun, to a length of something like 80 ft.

With a charge of 100 lb. of the newest powder to a shot weighing 400 lb., Sir Andrew Noble's velocity should be reached and exceeded and a comparison be drawn between calculation and practice. Meanwhile experiments on the model scale should not be despised, as they will give rapid and economical results, from which it is possible to predict a full-scale performance on the laws of mechanical similitude.

With the extra metal for strengthening the breech the gun would be heavy enough to prevent the recoil becoming unmanageable; and if the long chase should be too flexible, droop, and whip, it can be rigged like the bowsprit of a ship.

We can rely on our chemical, metallurgical, and engineering science to provide the material and shape it. But lead and direction are required of theory by preliminary calculation to show how to make use of our resources to the best advantage. As Bacon said: "Experiment not directed by Theory is blind. And Theory unsupported by Experiment is uncertain and misleading."

G. GREENHILL.

COLLOIDS AND CHEMICAL INDUSTRY.[1]

COLLOID chemistry, in its widest sense, deals with chemical processes which occur in the immediate neighbourhood of surfaces—that is, chemical effects which are brought about as a result of capillary and electrocapillary forces. Such effects are necessarily limited to a small range, the thickness of the capillary layer being of the order 10^{-6} to 10^{-7} cm. It is obvious that these effects can become of importance only if the surface area itself is very large. Under ordinary conditions, in which two fluid masses in bulk are separated by a definite surface—as in distribution phenomena—the capillary effects are too small to be observed. To magnify the effect it is usually necessary to realise a state of affairs in which one phase is distributed in a state of fine subdivision or "dispersed" through the other phase or medium. In these circumstances the total interfacial area is enormously great. We find such conditions in the case of fine suspensions (diameter of particle 10^{-4} cm. approx.), emulsions (diameter of particle 10^{-5} cm.), and colloid solutions (diameter of particle 10^{-6} cm. approx.). Colloidal solutions are systems in which the solute individuals or *sols*, though apparently soluble, have not broken down to the molecular limit, but consist instead of aggregates, composed roughly of several hundred molecules or atoms. Such soluble aggregates or *sols* will not diffuse through membranes (as Graham showed in his original work on the colloidal state), and thus differ markedly from the behaviour of dissolved crystalloids, *e.g.* salts.

The most fundamental problem in connection with such disperse systems is the problem of their stability. It is evident that uniformity in size of the particles plays an important part in this connection, as do also the electric charge and the Brownian movement which each particle possesses. The methods whereby the equilibrium is disturbed are equally remarkable and characteristic. A very minute amount of electrolyte added to a stable colloidal solution may bring about complete precipitation or flocculation of the *sol*, the *sol* separating out in a gelatinous form known as a *gel*. In some cases, and possibly in all—though this is a disputed point—such precipitation may be reversed. A closely allied phenomenon is that known as "peptisation," in which a substance, normally insoluble in a solvent, may be made to dissolve by the addition of a peptiser. This is illustrated by the stabilising or protective effect produced by a small quantity of gelatine (itself a colloid) upon solutions of colloidal metals, and also by the well-known phenomenon met with in the case of the hydroxides of zinc and aluminium which "dissolve" in excess alkali. Experiment has shown that the alkali may be dialysed away and the peptised colloidal hydroxide reprecipitated. Such phenomena depend essentially upon selective adsorption or surface condensation of certain parts of the peptiser (usually the hydroxyl ion) upon the suspension or colloid. Gibbs showed, many years ago, that, as a thermodynamic necessity, any substance (solute) which lowers the surface tension of the solvent is positively adsorbed at the surface—that is, the concentration of the solute is greater in the surface layer than it is in the bulk of the solution. This phenomenon lies at the basis of many technical operations, such as dyeing and tanning, though, of course, other effects of an irreversible character enter later.

Another important surface phenomenon is that known as electrical endosmose. If a liquid be divided into two parts by means of a porous partition or membrane, and an electromotive force be applied across the partition, the liquid will be found to pass through the membrane, the direction of motion depending upon the electrical state of the partition in relation to the liquid and its constituents. By a suitable choice of membrane and solution certain constituents may be separated from others, *e.g.* crystalloids from colloids, or certain colloids may be precipitated and others left in solution.

Surface effects, the realisation of colloid equilibrium, electrical neutralisation, preferential adsorption, peptisation, colloid precipitation, imbibition or swelling of *gels*, electrical endosmose, and other phenomena of a similar nature might at first sight appear to have little significance for industrial operations and processes, although their importance has already been recognised to a certain extent in other directions, *e.g.* in agricultural processes (quality of soils, retention of salts, emulsions for crop spraying, etc.), in geological formations, and in biological problems (cell contents, nature and permeability of cell-walls, distribution of electrolytes, blood serum, coagulation of proteins, enzyme action, etc.). That colloidal phenomena enter into numerous technical processes may be demonstrated by a brief enumeration of some industrial operations which depend fundamentally upon what we may call the principles of colloid chemistry.

We have already instanced dyeing and tanning. We find further that colloid chemistry plays a fundamental part in certain stages of soap manufacture; in washing and scouring processes, in connection with textile fabrics, hides, skins, and in fur dressing; in mercerisation and finishing; in the manufacture of photographic materials; in the treatment of cellulose and wood pulp in paper manufacture; in paper sizing and colouring (carbon and other copying papers); in the treatment

[1] First Report of the British Association Committee on Colloid Chemistry and its Industrial Applications. (1917.)

of gums, gelatine, albumin, starch, tragacanth, and adhesive materials generally; in the clarification of wines; in filtration processes, treatment of sewage, river sludge, and the function of charcoal purifiers; in the de-emulsification of water in steam turbines; in the preparation of medicinal emulsions; in the manufacture of margarine and other foodstuffs; in brewing and fermentation industries; in catalytic reactions, such as the hydrogenation process; in chemical analysis, electro-analysis, and electro-deposition processes; in the coagulation of rubber latex and in vulcanisation; in the manufacture of celluloid and celluloid products; in the flotation process of ore separation; in the manufacture and setting of cements, plaster, and mortar; in the preservation of building materials; in the manufacture of ruby glass, opaque glass, and enamel; and in the application of electrical endosmose to peat drying and the preparation of pure colloids for medicinal purposes.

The above rather heterogeneous list—by no means exhaustive—will give some idea of the variety and extent and consequent importance of colloid chemistry for the chemical manufacturer. It is an urgent matter that the great significance of this branch of chemistry should be recognised by all interested in the progress of chemical industry.

In the first report of the British Association Committee on Colloid Chemistry and its Industrial Applications, now before us, several of the processes mentioned above are discussed. The committee has aimed at compiling information regarding the advances which have been made in colloid chemistry itself and in its applications to industrial processes, with the object, in the first place, of making such information as widely available as possible, and, in the second, of emphasising the need for much greater attention being paid to this wide, but hitherto neglected, branch of chemistry. Each subject has been treated by an expert, so that the selection and presentation of material may be regarded as authoritative. It is evident that at the present time there is a very considerable "lag" between scientific knowledge in this field and industrial practice. The result is that the majority of working processes are largely empirical, their mechanism obscure, and the probability of improvement consequently small. This is obviously an extremely unsatisfactory state of affairs. The remedy lies, of course, in the vigorous prosecution of research over the entire range of colloid chemistry in the research laboratories of manufacturers and in the chemical departments of our universities. In this connection it is perhaps worth while to point out that there is not a single chair or independent department of colloid chemistry in any of our universities or university colleges. The time has surely come for development in this direction, in order that a subject of such present importance and possessing great possibilities may become a real source of strength to our chemical industries.

W. C. McC. LEWIS.

DR. G. J. HINDE, F.R.S.

By the death of Dr. George Jennings Hinde on March 18 another pioneer in the modern methods of studying fossils has passed away. Dr. Hinde devoted the greater part of his long life to the investigation of the remains of the lower invertebrate animals, which need careful and often laborious preparation for the microscope before they can be examined. He thus contributed much to geology by adding to our knowledge of rock-forming organisms, and at the same time promoted the advance of zoology by his discovery and description of many kinds of calcareous and siliceous skeletons, which were either entirely new or revealed new facts in distribution.

Dr. Hinde was born at Norwich in 1839, and emigrated in early life to the Argentine Republic, where he was engaged in sheep-farming. He was always interested in natural history, and as soon as the opportunity occurred at the beginning of the 'seventies he decided to retire from business and follow more congenial pursuits. He left Argentina for Canada, and proceeded to the University of Toronto, where the late Prof. H. A. Nicholson was then starting his professorial career. Stimulated by Nicholson's lectures and personality, Hinde began to follow his teacher in studying the Silurian and Ordovician fossils of Canada. He also became interested in the remarkable glacial deposits, which are so conspicuous a feature of the region in which he dwelt. Nicholson had specially devoted attention to the microscopic structure of the corals and obscure organisms which abounded in the limestones, and it was to the microscope that Hinde naturally turned as the chief instrument for his researches. He travelled extensively and collected industriously in Canada and the United States, where he remained for seven years. Among minute fossils his most important discoveries were conodonts and jaws of annelids in the Ordovician rocks.

Returning to England, Hinde found similar jaws of annelids in the Silurian rocks of this country, and described them in the Quarterly Journal of the Geological Society in 1880. In 1879 he recovered and prepared a remarkable collection of sponge-spicules from a hollow in a chalk-flint at Horstead, near Norwich, and soon recognised that most of them were new. He accordingly went to study his little collection at the University of Munich, under the direction of Prof. K. A. von Zittel, who had just completed there an important revision of the fossil sponges. Hinde published his results in 1880 in the form of a thesis, for which he received the degree of Ph.D. Returning finally to England, he next prepared a descriptive illustrated catalogue of the fossil sponges in the British Museum, which was published by the trustees in 1883; and this was followed by the first volume of a monograph of the British fossil sponges, issued by the Palæontographical Society between 1887 and 1893. Several smaller papers were also the outcome of his researches, the most important being an account of the cherty sponge-beds of the Greensand formation contributed to the Philosophical Transactions in 1885.

Hinde continued to pay much attention to cherts in later years, and showed that many of them were rich in the skeletons of radiolaria, which he described in detail. His skill in making preparations was indeed matched only by the patience with which he studied them; and it would be difficult to find more conscientious plodding work than that he accomplished when he examined and described the core from the boring in the coral-atoll of Funafuti for the report of the Royal Society's committee in 1904.

From 1882 onwards Hinde resided near London, and until 1900 he took a very active share in the administration of the Geological Society, serving three terms on the council and being a vice-president from 1892 to 1895. From 1897 until 1915 he was also an active member of council of the Palæontographical Society, and held the office of treasurer from 1904 to 1914. Whatever he undertook he carried out with intense thoroughness, and whenever he formed a judgment as to the right course to pursue, neither argument nor persuasion could alter his determination. He sometimes therefore found himself at variance with his colleagues, but his honesty of purpose was always so evident that he never lost their highest respect and esteem. His scientific worth led the Geological Society to award him the Wollaston fund in 1882, the Lyell medal in 1897, and he was elected a fellow of the Royal Society in 1896.

NOTES.

It was stated in the *Times* of March 21 that Dr. Addison, Minister of Reconstruction, had informed a deputation of Welsh members that a Government Bill for the establishment of a Ministry of Health would probably be introduced in the House of Commons immediately after the Easter recess. Agreement has been reached on the main principles of the measure as the result of conferences with the various departments and parties affected.

A WELL-ILLUSTRATED article by M. H. Volta on the relation of inventors to the problem of dealing with hostile submarines appears in *La Nature* for February 23. It seems that the French authorities have been overwhelmed with suggestions which as a general rule show a lamentable want of consideration of the conditions under which the search for submarines and the attacks on them, when found, have to be carried out. Half a dozen ingenious arrangements for netting them and either communicating the fact to the shore or to an attendant destroyer, from which the submarine is then bombed, or providing automatically for the explosion of a bomb when the net is touched, are described. Almost any of them would act in still water not used by surface boats, but none of them are of the least use in water constantly in tidal motion, often tempest-tossed, and with craft of all kinds on its surface. In the same way many of the suggestions for dealing with the problem by the help of aeroplanes display an extraordinary amount of ingenuity, but at the same time a candid ignorance of the conditions of flight and of stability of an aeroplane.

THE House of Lords, by a majority, has recently dismissed an appeal from a decision of the Court of Appeal affirming a judgment of Mr. Justice Astbury. The action was brought by the British Thomson-Houston Company to restrain "Duram," Ltd., from infringing a patent granted to the appellants for a process for the treatment of tungsten. The respondents disputed the validity of the patent. The appellants claimed that their invention consisted in the discovery that a mere built-up body of particles of tungsten which had hitherto been known only as a powder could be sufficiently consolidated together by prolonged heating below the melting point, and could then, if worked hot, be treated as though it were a solid piece of metal, that continuous lengths of wire of filament size could be produced therefrom, and that these particles of tungsten could be made so coherent that if hot they could be hammered, rolled, or drawn. Mr. Justice Astbury held upon the construction of the specification that the patent was void for lack of subject-matter in that it covered the working of tungsten while hot, and that the working of a hot metal was merely the utilisation of the tools and routine of the metal-worker, and was not the subject of invention. His judgment has been upheld, both in the Court of Appeal and in the House of Lords.

IT is sincerely to be hoped that the very timely appeal of the Duke of Rutland, in the *Times* of March 21, will not fall upon deaf or apathetic ears. His Grace directs attention to the very serious diminution of our truly insectivorous wild birds, and appeals to the authorities at Whitehall, when sending out their commands respecting the destruction of grain-eating wild birds, to urge strongly the advisability of sparing the truly insectivorous species. In May of last year Dr. W. E. Collinge pointed out in these columns the need for the Board of Agriculture to compel the preservation of such birds, and had the suggestion that this Board should establish a Bureau of Ornithology (*cf.* NATURE, October 15, 1915) been acted upon, the authorities would have been in possession of evidence which would have shown the real state of affairs as regards such birds, and would ere now have been ready to act. Since the commencement of the war up to the present time tens of thousands of acres of woods and forests have been destroyed in the British Isles. What the effect of this drastic change will be upon wild bird life it is difficult to foretell, but it seems very likely that it will mean a large decrease in the number of insectivorous birds, and as the stumps of recently felled trees in many cases provide an ideal breeding ground for insects, we shall probably, for some years to come, be troubled with plagues of various kinds of insects, in particular those that are injurious to forests. The unusually trying winters of the past two years have taken an enormous toll of tits, flycatchers, warblers, etc., and every protection should be afforded them at once.

THE meeting of the Institution of Mechanical Engineers on March 15 was eventful in that a paper was read by a lady—Miss O. E. Monkhouse—on the employment of women in munition factories. Roughly speaking, there are now close on one million women engaged on munitions; these may be divided into three types: (1) The educated type; (2) the domestic type; (3) the ordinary factory type. The first type are already half-educated for the better class of engineering work, and are taught easily; the second train readily into good charge hands and forewomen; and the last-mentioned type are best employed on purely unskilled work of a repetition nature. There are many cases where women have acquired a knowledge of engineering work in excess of what would have been learned by an apprentice in the same period under pre-war conditions. There are three causes for this:—(1) Women have been definitely taught, whereas the apprentice had to pick up the trade; (2) women have, for the most part, been intensively taught everything in the shop itself under production conditions rather than in the school; (3) the conditions of the time have spurred on everybody to greater effort, from patriotic motives. Experience has shown that women should be controlled and organised by their own sex if the best results are to be obtained; also that, wherever there has been proper consideration for women's welfare in factories, there has been no decrease in healthy physical development, and a decided increase in mental capacity.

SOME time ago the council of the Institution of Naval Architects appointed a committee to inquire into the effects of explosions of mines and torpedoes on the structure of merchant ships. This committee, in its report, states that the loss of many cargo vessels has been due to three causes:—(*a*) The existence of watertight doors low down in the bulkheads, which could not be closed after the explosion; (*b*) fractures of suction pipes in the attacked compartment permitting water to flow into adjacent compartments; (*c*) the penetration of bulkheads adjacent to the attached compartments by fragments of plating, frames, rivets, etc. The committee made several recommendations with the object of minimising these risks, and the Government has adopted and circulated most of these. Speaking in the discussion on Sir George Carter's paper on standard cargo ships, read at the institution's meeting on March 20, Mr. Sydney Barnaby, the chairman of the committee, said the committee had expected to find that the effect of the torpedo on merchant ships would be so severe that their survival could not be hoped for reasonably. They expected to find that large areas of the shell plating were disturbed and the riveting started, and that possibly bulkheads were carried away by sudden enormous inrushes of water. Their investigations showed nothing of the kind. Large as the holes were, the ship's structure was not affected even in the immediate neighbourhood, and bulkheads had never given way. In fact, ships were being sunk because watertight compartments were not actually watertight.

WE regret to record the death on March 21 of Dr. R. S. Trevor, pathologist at St. George's Hospital, dean of the medical school, lecturer in pathology, forensic medicine, and toxicology, and curator of the museum.

Science records the death, in his sixty-second year, of Prof. E. A. Engler, president of the Academy of Science of St. Louis. Prof. Engler was professor of mathematics at Washington University, St. Louis, from 1881 to 1901, and dean of the school of engineering there from 1896 to 1901. He was for ten years president of the Worcester Polytechnic Institute.

THE death is announced, in his sixty-first year, of Sir John Anderson, K.C.B., Governor and Commander-in-Chief of Ceylon since 1916. In 1901 Sir John Anderson was in attendance on King George, then Duke of Cornwall and York, as representative of the Colonial Office, during the Royal Colonial tour. From 1904 to 1911 he was Governor of the Straits Settlements and High Commissioner for the Federated Malay States.

THE annual general meeting of the Ray Society was held on March 14, the president, Prof. W. C. McIntosh, in the chair. The report of the council and the account of income and expenditure were read and adopted. Sir David Prain was elected a vice-president in succession to Prof. E. B. Poulton, retiring by seniority, Prof. McIntosh was re-elected president, Dr. S. F. Harmer treasurer, and Mr. John Hopkinson secretary.

THE annual gold medal of the Institution of Naval Architects has been awarded to Prof. G. W. Hovgaard, of the Massachusetts Institute of Technology, for his paper on "The Buoyancy and Stability of Submarines," and the premium to Mr. J. J. King-Salter, of Sydney, for his paper on "The Influence of Running Balance of Propellers on the Vibration of Ships." As already announced, the Martell scholarship for 1917 and the Earl of Durham's prize have been awarded respectively to Mr. H. C. Carey and Mr. H. D. Leggett.

A JOINT meeting of the Institution of Electrical Engineers and the Electrical Section of the Royal Society of Medicine will be held at the Cancer Hospital, Fulham Road, S.W., on Thursday, April 11, at 7.30 p.m., instead of at King's College, as previously announced. The following papers will be read:—Dr. E. P. Cumberbatch, "Diathermy: the Use of Electricity for Heating the Tissues of the Body in Disease"; Dr. R. Knox, "Single Flash (Instantaneous) Radiography: its Possibilities and Limitations." There will also be an exhibition of electro-medical apparatus.

THE annual general meeting of the Chemical Society was held at Burlington House on March 21, when the Longstaff medal for 1918 was presented to Lt.-Col. A. W. Crossley, C.M.G., for his work in the field of hydroaromatic compounds. Prof. W. J. Pope delivered his presidential address, and at the conclusion of his address it was announced that the following new members of council had been elected:—As new vice-presidents, Prof. F. G. Donnan and Prof. W. P. Wynne; and as new ordinary members of council, Mr. J. L. Baker, Prof. J. C. Irvine, Sir Herbert Jackson, and Mr. E. W. Voelcker.

THE annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 2 and 3. On the opening day the retiring president (Sir William Beardmore, Bart.) will induct into the chair the president-elect (Mr. Eugène Schneider), Sir William Beardmore will be presented with the Bessemer medal for 1918, and the president will deliver his inaugural address. On May 3 the award of grants from the Andrew Carnegie Research Fund in aid of research work will be announced. Twenty-one papers are included in the list for the meeting, and selections from them will be read and discussed.

THE death is announced, in his sixty-seventh year, of Dr. Samuel G. Dixon, professor of bacteriology and microscopic technology at the Academy of Natural Sciences, Philadelphia, since 1890, and president of that institution since 1896. For more than twenty years he was professor of hygiene at the University of Pennsylvania. His principal work was done in the prevention and treatment of tuberculosis, and his controversy with Prof. Koch over the priority of discovery of a method of preventing that disease in the lower animals created considerable stir in the scientific world some years ago. Of late years Dr. Dixon had rendered exceptional service in connection with the Department of Health of the State of Pennsylvania, of which he was placed at the head as commissioner when it was established in 1905.

THE following are among the lecture arrangements at the Royal Institution after Easter:—Prof. John Joly, two lectures on scientific signalling and safety at sea; Prof. Arthur Keith, five lectures on British anthropologists; Lt.-Col. C. S. Myers, two lectures on present-day applications of experimental psychology; Sir James Frazer, two lectures on (1) the folk-lore of bells,

(2) the prosecution and punishment of animals; Lt.-Col. Sir Francis Younghusband, three lectures on the abode of snow: its appearance, inhabitants, and history; Prof. E. H. Barton, two lectures on musical instruments scientifically considered; Prof. H. F. Newall, two lectures on modern investigation of the sun's surface; Prof. C. J. Patten, three lectures on problems in bird-migration. The Friday meetings will commence on April 12, when Prof. E. C. C. Baly will deliver a discourse on absorption and phosphorescence. Succeeding discourses will probably be given by Major G. I. Taylor, Sir A. Daniel Hall, Sir George Greenhill, Prof. F. Gowland-Hopkins, Dr. A. Barton Rendle, and Sir Boverton Redwood.

THE annual report of the council of the Institute of Metals, presented at the recent annual general meeting, shows that the stimulating influence of war conditions upon the activities of the institute has continued to make itself felt during the year. The more general employment of scientific metallurgists in works engaged directly and indirectly in the production of munitions of war has aroused the interest of technical and scientific experts and of manufacturers in the work of the institute, and this has led to a large increase in the applications for membership. The research work organised by the Corrosion Research Committee is still being conducted with the assistance of funds contributed by the Department of Scientific and Industrial Research, by various associations and manufacturing firms, and by the institute. The Government grant-in-aid was increased during the year from 650*l*. to 1000*l*. per annum. A further Government grant-in-aid of 450*l*. has been received, together with a grant of a similar amount from the British Electrical and Allied Manufacturers' Association. The aggregate sum of 900*l*. has been placed at the disposal of the institute in order to carry out an investigation into the cause of the corrosion of condenser tubes on land by fresh water. For the purpose of conducting this investigation, a Fresh-water Corrosion Research Committee was appointed as a subcommittee of the Corrosion Research Committee.

ANOTHER Indian "miracle" has been explained by scientific investigation. The *Pioneer Mail* of January 11 reports a lecture by Sir J. C. Bose on "The Praying Palm Tree" of Faridpur. While the temple bells call the people to evening prayer, this tree has recently been seen to bow down in prostration, and to erect its head on the following morning. Large numbers of pilgrims have been attracted to the place, and offerings to the tree are said to have been the means of effecting marvellous cures. Sir J. C. Bose first procured photographs which proved the phenomenon to be real. The next step was to devise a special apparatus to record continuously the movement of the tree by day and night. The records showed that it fell with the rise of temperature and rose with the fall. The records obtained in the case of other trees brought out the fact that all the trees are moving, each movement being due to changes in their environment.

THE history of William Bullock's famous museum, by Mr. W. H. Mullens, which appears in the *Museums Journal* for March, will be read with interest by all who are concerned with the rise and development of museums in this country. This account, which is not yet completed, is devoted to an analysis of the various editions of the catalogue, or "Companion," which served as the guide to the collections, and to the description of the final dispersal of the museum and its contents by auction, which took place in 1819. This issue of the *Journal* also publishes an appeal to museums from the Ministry of Food urging them to spare no effort to instruct the public as to ways and means of food production and food conservation. We are glad indeed to find that the purposes of museums are at last recognised by the Government as serving something more than "places of innocent amusement," activities which, in time of war, might well be suspended. But the work now suggested was put in hand in most museums long since. Nevertheless, this recognition is a hopeful sign. Our museums will be found only too willing to respond to every plea made to them to enlarge the sphere of their activities.

A VERY careful study of the nesting habits of the kingfisher (*Alcedo ispida*), by Mr. W. Rowan, appears in *British Birds* for March. Though brief, this essay adds several points of real value to our knowledge of the life-history of this bird, and, besides, sets at rest one or two matters which have long been in dispute. It is shown, for example, that two broods may be reared during a single season, and that the male takes part in brooding the young. As to whether they are fed at first by regurgitation or not Mr. Rowan was not able to satisfy himself, but it seems clear that the food given during the early stages of development consists of small crustacea and not fish, for fish were not brought to the nest until the young were several days old. By great good fortune observations were also made on the nestlings, first, while making the peculiar purring noise which has been frequently described, but probably never before witnessed, and secondly, during the act of defæcation. The voiding of the fluid excrement by the nestlings of this species assumes importance, having regard to the fact that the nest is placed at the end of a long tunnel. Being fluid, it could not be carried away by the parents, so that only by its forcible ejection from the mouth of the tunnel can the nest be kept clean.

THE Madras Fisheries Bulletin (No. 4, vol. xi., 1917) consists of an interesting account of the Indian bêche-de-mer industry, written by Mr. James Hornell. Only one species of Holothurian (*Holothuria scabra*) is utilised commercially, the other abundant species being either too small or too gelatinous to cure. The Indian curing industry is of considerable antiquity, and it seems to have been introduced by immigrant Chinese. These men are said to be most careful and conscientious workers, and are generally very successful until they become ousted by local fishermen, who are exploited by Mohammedan merchants. As the result of a boycott and the promotion of a rival curing-house, the Chinese exporter become expropriated; the local curers adopt his methods, but gradually allow them to deteriorate until, in turn, the trade languishes and dies out, and is revived by some other Chinaman. Mr. Hornell gives an account of the successful work done by the Madras Government in erecting and running an experimental curing station in Palk Bay. Certain improvements in methods were introduced, and these are described. Statistics of the general Eastern trade in bêche-de-mer during recent years are appended.

THE cheese mite is the cause of much damage to cheeses, especially the unpressed, ungreased cheeses of the Stilton and Wensleydale types. The attacks of this pest give rise to a serious depreciation, both in appearance and value, and in extreme cases nearly one-half of the cheese may be eaten away. An interesting account of experiments and observations on this problem is contributed by Miss N. B. Eales, of the Zoology Department, University College, Reading, to the January issue of the *Journal of the Board of Agriculture*. It was demonstrated that live mites persist in the cheese room throughout the period from December to April when the room is not in use, despite the greatest care in the application of the ordinary cleansing methods. Further experiments showed that the mites could be carried by flies and moths. The common practice of dipping mite-attacked cheeses in hot water or steaming them was found to be useless as a remedy. Fumigation with sulphuretted hydrogen or sulphur dioxide was also futile. Treatment with carbon bisulphide proved very successful, but treatment with formalin was ineffective. In an experiment with carbon dioxide the mites revived after a period of suspended animation lasting for ninety-six hours. Methods of prevention of mite attacks are indicated, and the article, which is illustrated, also includes brief notes on the systematic position, species, and life-history of the mites.

GREAT interest has been taken throughout the wide circle of his acquaintance in the experiment which Prof. W. Somerville has been conducting during the last seven years on his aptly named farm of "Poverty Bottom," with the object of demonstrating in actual commercial farm practice the soundness of the view he has so long and ably advocated, that the improvement of English land offers in many parts of the country an investment of a highly remunerative character. For his purpose a poor, thin soil on the chalk seemed to be best suited as an object-lesson, in view of the fact that the Cretaceous system is the most extensive single geological formation in England, and hence results obtained in it would be capable of wide application. In February, 1910, Prof. Somerville entered into possession of "Poverty Bottom," a farm of 530 acres, situated on the South Downs near Newhaven, and at the time untenanted, unstocked, and apparently all but barren. The outstanding measures of improvement adopted were the liberal application of basic slag, clearing off gorse, sowing of clovers, including wild white clover, and the admixture of cattle with sheep on the pastures. The use of basic slag has effected a very striking improvement of the pasturage through the development of the leguminous herbage, and the tillage land has shared in the improvement through the transference to it in the manure of nitrogen collected in the meadows. Seven years' farming has now been experienced, and the results are summarised in a most interesting article by Prof. Somerville in the current issue (February, 1918) of the *Journal of the Board of Agriculture*. This article gives many details of the system of improvement followed which cannot be summarised here. It is estimated that the head of stock has been increased by 50 per cent., whilst, when the higher quality of the stock is taken into account, the productivity of the farm in terms of meat has been increased threefold in six years. The net financial result in any year was very largely a question of weather, but on the whole period, after deducting losses, rent, etc., a credit balance of more than 2200*l.* remains. The average yearly remuneration of the farmer, it is estimated, would represent a sum of 338*l.*, together with a free house, as a return for the investment of some 4000*l.* of capital.

A RECENT bulletin (No. 102, part i) of the Smithsonian Institution provides, under the title "The Mineral Industries of the United States," a useful popular account of coal and products from coal, which may be read with advantage on both sides of the Atlantic. The writer, Mr. Chester G. Gilbert, is curator of mineral technology in the U.S. National Museum, and his object appears to be to urge the importance of co-ordination and scientific control of chemical industries. This lesson will have to be learned in this country no less than in the United States, but progress in this direction will depend very much on the support given by public opinion. As, however, few of the public know much about such questions, anything which helps towards a popular understanding of them is useful. This bulletin gives within sixteen pages of print an outline of the origin of coal, a comparison of the amount of coal deposits in the several countries of the world, and an indication of the methods used in the production of coke, gas, and the other volatile products obtainable by the application of heat. The illustrations added include a curious diagram of the products derived from coal and some of their uses, which will serve to show to the uninitiated the complex character of coal chemistry.

WHEN heat flows through the surface of a solid to or from a gas in contact with the surface, it is well known that the layer of stagnant gas close to the solid interposes a considerable resistance to the flow. When the object of the arrangement has been to get the maximum flow, it has been the custom to make the gas flow rapidly over the surface of the solid. The advantage of this was pointed out by Osborne Reynolds in 1874, and it has been verified experimentally by Stanton in 1897, Nicolson in 1905, and more recently by Jordan (Proc. Inst. Mech. Eng., 1909). Another method of obtaining the same result is described by Dr. C. Hering in a paper on "A New Principle in the Flow of Heat," in the January number of the Journal of the Franklin Institute. It is found that the resistance of the film of gas in contact with the solid may be greatly reduced by increasing the temperature of the surface of the solid. The flow through the bottom of a kettle may, according to Dr. Hering, be increased twenty-sevenfold by raising the temperature of the metal surface in contact with the gas flame to 725° C. This can be done by interposing a thermal resistance between the surface in contact with the flame and that in contact with the water. It is proposed to secure the same result in steam boilers by attaching metallic lugs to the flame side of the flue, of such length that their ends will be at about 725° C. The results of a trial of the method on a practical scale will be awaited with considerable interest.

AN interesting discussion on nitre-cake held by the Nottingham Section of the Society of Chemical Industry is reported in the Journal of the society for December 15 last. According to Mr. G. C. Grisley, the most successful method of utilising nitre-cake is to substitute it for sulphuric acid in the manufacture of hydrochloric acid and salt-cake from salt. It has also been employed to obtain ferric sulphate for sewage precipitation by furnacing burnt pyrites with nitre-cake, grinding, and leaching the product with water. Further, it could be used as a diluent for sulphuric acid in the manufacture of superphosphate. Dr. Terlinck stated that he had used nitre-cake as a substitute for sulphuric acid in the recovery of fats from wool wash-waters, and he proposed to use it in the purification of ammonium salts. The necessity for workmen who handled nitre-cake being provided with wooden clogs and india-rubber gloves was emphasised by Mr. W. G. Timmans, who stated that in the Nottingham district nitre-cake was used for lace bleaching, grease extraction from wool, pickling metals, and mineral-water manufacture. Dr. E. Naef pointed out that the suggestions hitherto advanced were based on the acidity of the nitre-cake, and that the sodium sulphate remaining had still to be utilised. One way of doing this was to reduce it to sodium sulphide by grinding with anthracite, charcoal, or boiler coal and heating at 500°–600° C., the yield obtained being 95–98 per cent. Sulphur dioxide is evolved if nitre-cake (rather than sodium sulphate) is used, but this could be avoided by neutralising the free acid with soda ash during the grinding. For the production of sulphur dyes alone 50,000 tons of sodium sulphide are required per annum. Dr. Naef has found that by treating nitre-cake at 300°–350° C. with superheated steam 90 per cent. of the free acid is driven off, but the product is too dilute to concentrate.

VOL. ii., No. 4, of the Memoirs of the College of Science, Kyoto Imperial University, contains a series of metallographical publications by Prof. Chikashige and his pupils. These deal with the working out of the equilibrium diagrams of the following series of binary alloys: (1) Tellurium and aluminium, and (2) selenium with antimony, cadmium, zinc, and aluminium respectively. The methods adopted are those in general use and do not call for any special mention. The authors content themselves with the determination of the main features of the diagrams, without saying anywhere whether any of the alloys are likely to prove of practical value.

THE reviewer of Dr. Knox's book on "Radiography and Radio-therapeutics," in NATURE of March 14, remarked: "We regret the omission of the bibliography." The publishers direct our attention to the fact that a selection of the literature of the subject appears on p. iv. at the end of the volume. We are sorry that our reviewer did not notice this bibliography in spite of having looked for it, and that he incorrectly said it had been omitted.

OUR ASTRONOMICAL COLUMN.

PLANETARY PERTURBATIONS AND ÆTHER-DRIFT.—In a paper entitled "Continued Discussion of the Astronomical and Gravitational Bearings of the Electrical Theory of Matter" (*Philosophical Magazine*, February, 1918), Sir Oliver Lodge continues a discussion commenced by the suggestion that the shift in Mercury's perihelion might be explained by a drift of the solar system through the æther. Prof. Eddington showed that a drift that would account for this would bring inadmissibly large errors into the other elements of the inner planets. Sir Oliver Lodge admits an error in his former work in the following words: "If the additional inertia due to motion is acted on by gravity the varying factor *m* will enter twice into the equation of motion and the perturbation will be increased instead of being annihilated." Making this change, he examines once more whether it is possible to find a drift that will satisfy the observed perturbations within their limits of error. After many trials, he concludes that they cannot all be satisfied in this way. He tends to the conclusion that gravity has joined the conspiracy to defeat our efforts to detect motion through the æther, and that we are led to accept the conclusion that the gravitation-constant itself is a function of the speed of the attracting masses. In support of this he quotes some electrical results which lead him to believe that electrical attraction does actually vary with speed. "If such a fact be established [for gravity] it may begin to throw some light on the family relationship of that force."

PERTURBATIONS OF NEPTUNE'S SATELLITE.—In a communication to the *Observatory*, for March, Prof. Armellini states the chief results of an investigation referring to the well-known perturbations of the satellite of Neptune. The pole of the satellite's orbit describes a circle about a point in R.A. 288° and declination 40°, and two hypotheses have been suggested to account for this motion. Tisserand attributed it to the attraction of the protuberant matter about the planet's equator, whilst H. Struve suggested that it might be due to some unknown perturbing mass. Prof. Armellini has investigated the latter hypothesis on the supposition that the unknown body is a satellite, which may not have been observed on account of its small mass. He has shown that a satellite having a mass sufficient to explain the observed perturbations would probably not be much fainter than the 14th magnitude, and would be unlikely to have escaped detection. Struve's hypothesis is accordingly considered much less probable than that of Tisserand.

MOTION OF OUR STELLAR SYSTEM.—Dr. V. M. Slipher, director of the Lowell Observatory, has made a preliminary investigation of the motion of our stellar system, on the supposition that the spiral nebulæ are stellar systems, similar to our own, situated at very great distances (Proc. American Philos. Soc., No. 5, 1917; quoted in Journ. R.A.S. Canada, vol. xii., p. 72). The radial velocities of twenty-five spiral nebulæ have been determined, and the motion of our system with respect to them has been derived in the same way as that of the sun with respect to the stars of our own system. The somewhat scanty material available indicates that we are moving in the direction of R.A. 22 hours, and declination −22°, with a velocity of about 700 km. per second. Dr. Slipher considers that these observations strengthen the view that our stellar system and the Milky Way are to be regarded as a great spiral nebula which we see from within, and that if the solar system has evolved from a nebula, the nebula was probably not one of the class of spirals dealt with in this investigation.

FOOD RATIONS FOR MANUAL WORKERS AND SCIENTIFIC LABORATORIES.

IT has been announced in the Press that the Ministry of Food intends to grant extra rations to manual workers from some date after April 7. The extra ration will not be ordinary butcher's meat, but bacon; and the eligibility of applicants will be determined by sub-committees of the local Food Control Committees, to which the Food Ministry will issue a classification of those persons entitled to extra food. The motive of this proposal is evidently sound from the scientific point of view. Considerable difficulties are, however, likely to arise in practice owing to the lack of exact knowledge respecting the energy needs of different kinds of industrial work. Relatively few experiments have been made and published, those of Amar upon metal filers being the best known. It is to be hoped that the scientific advisers of the Food Ministry will organise physiological investigations to elucidate disputed points. Complete calorimetric measurements are, of course, impracticable, but sufficiently precise results can be reached through a study of the respiratory metabolism by Zuntz's method, the apparatus needed for which is portable.

The Medical Research Committee has recently brought to the notice of Lord Rhondda the special difficulties confronting the directors of pathological and other scientific laboratories in the regulations relating to food supply. Many instances have been brought to the notice of the committee in which scientific work of the highest national importance has been endangered by difficulties in obtaining under existing conditions necessary foodstuffs in sufficient amount or variety, though the total amount required is quite negligible in relation to the general food supply. The Ministry of Food has now issued the following memorandum for the guidance of Food Control Committees:—

SUPPLIES OF FOODSTUFFS TO PATHOLOGICAL LABORATORIES.

(1) Lord Rhondda's attention has been directed to the difficulties experienced by scientific laboratories in obtaining the small quantities of foodstuffs required by them for the purposes of their scientific work.

(2) These laboratories throughout the country are engaged on work of the greatest importance both for civilian medical practice and for the maintenance of the health of the Navy and Army.

(3) The Food Controller is authorising laboratories duly licensed by the Home Office under Act 39 and 40 Victoria, cap. 77, to obtain supplies of any rationed article on production to the supplier of a certificate signed on behalf of a laboratory to the effect that they are necessary for the purposes described above. In due course special order forms will be issued to such laboratories for this purpose. Committees should also assist such laboratories in obtaining necessary supplies of unrationed foodstuffs in case they experience difficulty in securing them.

(4) A statutory order will shortly be issued by the Ministry of Food exempting from the provisions of the Food Controller's orders the use of grain and other foodstuffs in any such licensed laboratories for the maintenance of animals or for the preparation of laboratory materials.

THE PALMS OF SEYCHELLES AND THE MASCARENES.

SINCE the publication, just forty years ago, of Dr. I. B. Balfour's elaboration of the palms in J. G. Baker's "Flora of Mauritius and Seychelles," there has been considerable botanical activity in the islands of the Indian Ocean. Cordemoy's "Flore de l'Ile de la Réunion" appeared in 1895, and many novelties have been discovered, especially in Mahé, and published; but no addition has been made to the number of genera and species of palms inhabiting this insular region. Nevertheless, a number of interesting facts have come to light, partly through Prof. Stanley Gardiner's published notes, partly through various collectors' notes, and especially through Mr. P. R. Dupont's direct communications. Mr. Dupont, it should be explained, has been for many years curator of the Botanic Station at Mahé, and has thoroughly explored that island and more or less the rest of the Seychelles group, famous for its peculiar palms. The following table shows the composition and distribution of all the palms of the islands of the western Indian Ocean, excluding those of Madagascar:—

Distribution of the palms of Seychelles and the Mascarenes—Genera and Species		Seychelles	Rodriguez	Bourbon	Mauritius
Lodoicea sechellarum	Borasseæ	×			
Latania commersonii	Borasseæ			×	×
,, *loddigesii*	Borasseæ				×
,, *verschaffeltii*	Borasseæ		×		
Hyophorbe indica	Areceæ			×	×
,, *amaricaulis*	Areceæ				×
,, *verschaffeltii*	Areceæ		×		
Dictyosperma alba	Areceæ		×	×	×
Acanthophoenix rubra	Areceæ			×	×
,, *crinita*	Areceæ			×	×
,, *nobilis*	Areceæ	×			
Nephrosperma vanhoutteana	Areceæ	×			
Roscheria melanochaetes	Areceæ	×			
Verschaffeltia splendida	Areceæ	×			
Stevensonia grandifolia	Areceæ	×			
		6	3	5	7

With possible exceptions in Madagascar, the genera named in this table are restricted in their natural distribution to the islands and groups of islands named, and the Seychelles species and two out of three of the Rodriguez species are endemic, while the five Bourbon species are common to that island and Mauritius. Lodoicea and Latania are diœcious, and belong to the tribe Borasseæ, which is restricted to the African region in a broad sense, and comprises only two other genera, namely, Borassus, the palmyra, and Hyphæne, to which the characteristic branching palms of Africa belong. The rest of the genera in the table are all referred to the large, and generally dispersed, tribe Areceæ. Palms constitute the most striking feature in the vegetation of Seychelles, especially of the principal island, Mahé, where five out of the six species were formerly more or less abundant, and still persist in plenty. Lodoicea, the coco de mer, or double coconut, does not occur in a wild state in Mahé. Travellers have differed in opinion as to in which of the islands it is really indigenous, but trustworthy evidence points to Praslin, Curieuse, and Round Islands. A statement to this effect, by J. Harrison, appears in the *Botanical Magazine* for 1827, in the text to plates 2734–38. There is the further statement that this palm was "growing in thousands close to each other, and the sexes intermingled." Mr. Dupont communicates independent testimony to the existence of local evidence confirming this record. In favourable situations the double coconut attains a height of 100 ft., or occasionally even more.

Little is on record of the general distribution in the islands of the palms of Seychelles; but Dupont furnishes the following particulars of their altitudinal distribution in Mahé:—

Nephrosperma	0–300 m.	Acanthophœnix	0–750 m.
Stevensonia	150–600 ,,	Verschaffeltia	150–750 ,,
Roscheria	600–900 ,,		

He also distinguishes three zones of the predominating palms in Mahé:—

Zone of *Stevensonia grandifolia*	...	150–300 m.
Zone of *Verschaffeltia splendida*	...	300–600 ,,
Zone of *Roscheria melanochaetes*	...	600–900 ,,

These palms constitute a striking feature in the vegetation of Seychelles, especially that of Mahé, where they are associated with other singular endemic types belonging to various families. In stature and foliage they conspicuously overtop most of the other trees, with an average height of the five species of 45 to 65 ft., and extreme heights of *Acanthophoenix nobilis* of 80 to 120 ft., and of the magnificent *Verschaffeltia splendida* of 80 ft. All these palms are, or have been, in cultivation in the United Kingdom, but are rarely seen on account of their large dimensions and heat requirements. But characteristic paintings of all these palms are to be seen in the Seychelles section of the north gallery at Kew, together with many other of the endemic types of the archipelago. It may be worth mentioning here that some confusion has arisen in consequence of the local misuse of the terms male and female of the double coconut. This palm is really diœcious, and the large fruit is usually either two- or three-lobed, the two-lobed being named female and the three-lobed male! The presence of so many endemic palms in a small insular flora is almost unique in the geographical distribution of plants. Lord Howe Island, situated about 300 miles off the coast of New South Wales, presents the nearest approach to a parallel, supporting, as it does, four endemic palms belonging to three different genera, two of which are peculiar to the island. The profusion and elegance of these palms excite the admiration of all who see them. Of the Howe palms, *Kentia belmoreana* is one of the very best for dwelling-room decoration, the writer having kept a plant in excellent condition for twenty-six years.

In connection with the insular distribution of palms, it may be added that New Zealand, the Kermadec Islands, Norfolk Island, Juan Fernandez, and Bermuda each possess one species of palm, which seems to indicate a very ancient vegetation. The coconut is left out of consideration here, because Mr. O. F. Cook seems to have proved beyond doubt that it is of American origin, and that it owes its present distribution almost entirely to human agency.

W. BOTTING HEMSLEY.

NATIONAL LABORATORIES AND INDUSTRIAL DEVELOPMENT.[1]

I.

A NATIONAL INDUSTRIAL RESEARCH LABORATORY.

SOME seventeen years ago I spoke in this room on "The Aims of the National Physical Laboratory." I endeavoured to make clear the reasons for its establishment and to indicate some of the work we hoped to accomplish. I concluded:—"It has been my wish to state in general terms the aim of the laboratory to make the advances of physical science more readily available for the nation, and then to illustrate the way in which it is intended to attain these aims. I trust I may have shown that the National Physical Laboratory is an institution which may deservedly claim the cordial support of all who are interested in real progress."

Much has happened since then; how far we can assert that we have made good is for others to say. At any rate, our growth and the generous aid we have been given by many valued friends are evidence that the support for which I asked has not been wanting. And now that another great change in our position is about to take place and, as I trust, a wider sphere of usefulness is offered to us, it is not unfitting to put on record something of what has been done and to indicate, though it must only be in general terms, plans for the future. "Plans for the future": to-day it is hard to plan; one thought only fills all our minds, and every effort is needed to secure that victory without which future plans are useless.

Let me commence, then, with a few statistics as to growth and work. In 1901 the staff consisted of three scientific assistants working in some small rooms at the Kew Observatory, and the former observatory staff; the income was perhaps 5000*l*. When I lectured last arrangements were in progress for moving the laboratory to Bushy House, Teddington. To-day—or rather from April 1, 1918—we shall be organised in eight different departments, each with its own superintendent and a large staff of scientific assistants and observers. The staff now numbers well above 500 persons, of whom about 180 are women. The expenditure during the current financial year will be considerably above 100,000*l*.

As to finance, it may be of interest to give some figures. The ordinary expenditure—excluding sums spent on capital account—increased from 5479*l*. in 1900 to 38,003*l*. in 1913–14, the total income from January, 1900, to March 31, 1914, being 282,545*l*. The sources of this income were distributed thus:—

Treasury grants to the laboratory ...	£80,500
Treasury grants for aeronautics ...	20,182
Receipts for work done	166,633
Donations	15,230
	£282,545

During the same period the capital expenditure was 156,198*l*., provided thus:—

From Treasury grants	£75,941
From private donations	55,967
Provided out of income	24,290
	£156,198

The enormous growth in expenditure from 38,000*l*. in 1913–14 to more than 100,000*l*. this year is, of course, due to the war.

During this period the ultimate control of the laboratory has rested in all particulars with the president and council of the Royal Society. They have been responsible for the finances of the institution. Any loss—I am glad to say there has been no loss—would have fallen on the funds of the society; the laboratory, in spite of its name "National," has really been a private concern of the Royal Society, supported most cordially throughout by six of the leading technical societies, and dependent for part of its income on a grant-in-aid from the Treasury, but in the main from the receipts from fees.

From April 1 of this year there is to be a change. The scientific control of the laboratory is still to be exercised by the president and council of the Royal Society; the property of the laboratory is to be vested in the Imperial Trust for the Encouragement of Scientific and Industrial Research—it is now vested in the Royal Society. The income of the laboratory, including receipts from fees, is to be vested in, and is to be under the control of, the Committee of the Privy Council for Scientific and Industrial Research. The laboratory will be managed by an Executive Committee appointed as heretofore, and containing representatives of the great technical societies. In this manner it is hoped to secure financial stability and to retain at the same time the great benefits which have come from the close connection with the Royal Society.

In the future, as in the past, the laboratory will endeavour to discharge two functions; it will be a laboratory of industrial research, and a national testing institution or proving house. To-day we deal with the laboratory of industrial research.

Industrial research—what is it? In recent years much has been written on this subject; the idea of a laboratory devoted to industrial research is by no means novel, and the steps by which ordinarily a scientific discovery develops into a manufacturing process are generally recognised. First and foremost we have the research student impelled by his thirst for knowledge; his desire to penetrate ever deeper into the mysteries of Nature; he does not work with the deliberate intention of making something of service to humanity. Faraday's discoveries of electromagnetic laws, made in this building, were at first as useless as the new-born babe, but had within them that power and potency which have transformed the industry of the world. Röntgen, when he discovered X-rays, or J. J. Thomson, when he tracked down ions and corpuscles in the manner he has often demonstrated here, thought little of their application to surgery and the countless benefits they have brought to suffering humanity.

There must be institutions where research work is carried on for its own sake, where—to apply Sir J. J. Thomson's recent remark—men may make discoveries which may revolutionise and not merely reform the world, where they may train students in those fundamental laws and principles which must be at the root of every successful endeavour to apply science to industry. But there is a wide gap between such homes of science and the works of the manufacturer, and it is to fill this that laboratories of industrial research are needed.

[1] Abridged from two lectures delivered at the Royal Institution on February 26 and March 5 by Sir R. T. Glazebrook, C.B., F.R.S.

Or, again, looking at our problem from the opposite side, a manufacturer has some question to solve—the utilisation of a waste product which, if it were not waste, would make all the difference between commercial failure and success, the discovery of a material with some special properties—*e.g.* a light alloy of great strength at a high temperature—needed before a new machine can be completed. Such a man must have access to a laboratory fitted and equipped for the purpose with a trained staff having stored experience as the result of previous work or researches on cognate questions. Let me try to indicate some of the methods in which the National Physical Laboratory has endeavoured to fulfil these duties.

Three of the researches referred to in my earlier lecture related to the production of optical glass, the work of the Alloys Research Committee of the Institution of Mechanical Engineers, and the measurement of wind pressure on various structures and surfaces. On all these subjects much has been done. It was some time before the authorities could be persuaded that in neglecting to study the production of optical glass in England they were adding seriously to the risks and dangers of war. Many years ago a strong committee, formed under the chairmanship of the late Sir David Gill, took the matter up and laid before the Government a scheme for a complete study of the problem. Nothing was done until war taught us the need for attending to key industries, but since then real advances have been made, not only at the laboratory, but elsewhere also, and some of the more serious difficulties of the problem have been overcome; it is hoped that in the near future it may be possible to introduce changes of procedure which will greatly simplify the process of manufacture and lead to an increased output. Closely bound up with this is the study of the properties of refractory materials used in furnaces and elsewhere.

But it is sometimes urged: "Why do you need a special laboratory for such work? Can it not be done equally well in one of the university or technical college laboratories? Is it not enough to multiply and organise these, to bring the teachers into direct contact with the manufacturers of their districts, and to encourage the students at an early stage to interest themselves in the scientific problems they will have to solve later in their daily work?" To this my answer would be that it is not enough. The primary work of the professor is to teach and to advance knowledge, while that of the student is to learn how to research and to apply his knowledge. The professor will no doubt keep in close contact with the industry, and take his illustrations from the manufactures of his district, but before his students can usefully engage in industrial research they must have a thorough grasp of the principles underlying all research and of the methods of employing them. Industrial problems are usually too complex for students, and, moreover, the answers are wanted too rapidly to make them subjects of a student's exercise; he will learn by failures; by the inexperienced the right road is found at last only after many tempting tracks leading nowhere have been vainly tried. The manufacturer who comes with a problem which cannot wait will be more sure to find a solution if he applies to men whose daily work it is to attempt such problems, and who have the experience of the past to guide them. Moreover, the plant and equipment required are special; the industrial research laboratory must be fitted on the industrial scale. A rolling-mill is not an adjunct required in every technical school where the principles of metallurgy are taught, and yet without a rolling-mill the study of the light alloys at the National Physical Laboratory could not have been brought to the pitch it has been. The plant and equipment of an industrial research laboratory are provided for the purpose of applying science to industry. The requirements of students and the educational value of the apparatus need not be studied. There must, of course, be many specialised laboratories of industrial research; much more than the National Physical Laboratory is required. I will return to that point later. At present I merely wish to urge that university and technical college laboratories cannot fill all our needs.

And now let me come back to another illustration of the industrial research done at the laboratory closely connected with our original work on wind pressure. The Advisory Committee for Aeronautics was first appointed in 1908 by Mr. Asquith, then Prime Minister. It owes its inception to Lord Haldane, and much of the experimental work which it has initiated, and which has had so marked an effect on the efficiency of British aircraft, has been carried out at the laboratory. At present there are five air channels in practically continuous use, and more are being erected. Some years ago I gave some account here of the work by which Bairstow and Busk, starting from Bryan's theory, had solved the problem of stability. It is impossible to tell at present of the progress made since that time, but when the day comes on which the tale can be told it will form a striking example of the work of a laboratory of industrial research, and the results obtained for purposes of war will bear fruit in the rapid progress of civilian aircraft.

And now, turning to the future, let us consider what is to be the position of the institution as a central laboratory of industrial research.

In a lecture delivered in Birmingham rather more than a year ago, shortly after Lord Crewe had announced the formation of the Department of Scientific and Industrial Research, I referred to such laboratories, and I said:—

"There must be more than one; in many cases an industry can be best served by a laboratory near its principal centre. Large firms, again, may each prefer to have their own trade secrets—this must be so to some extent—and trade jealousies may interfere with full co-operation, but a private laboratory on a really sufficient scale is expensive; too often it becomes little more than what I have called a works laboratory for testing the products of the factory, and, for the smaller firms at least, the only way to secure the full advantage of scientific advance is by co-operation—co-operation in the laboratory, co-operation, with specialisation in production, in the works themselves. . . .

"The body controlling industrial science research must have access to a laboratory in which may be studied the many problems which do not require for their elucidation appliances of the more specialised 'works' character, or opportunities only to be found in particular localities; where a staff is available, able and experienced, ready to attack under the advice of men skilled in industry the technical difficulties met with in applying new discoveries on a manufacturing scale or to develop ideas which promise future success.

"Such a *rôle* the National Physical Laboratory should be prepared to play; such is the future which I trust may be in store for it."

This work has already been begun. The various trades associations have been, or are being, formed for the promotion of research on matters of interest to the members of the trade.

Each such association will probably require its own laboratory, situated, for preference, at the centre of the trade concerned. This will deal with the special problems of the trade, problems which need intimate association with works conditions for their solution and for which the close supervision of men in works is important.

But there are numerous industrial problems which can best be dealt with in a central laboratory; let me give some instances of what I mean. Such, for example, are:—

(1) Investigations into methods of standardisation or of measurement generally.

(2) Investigations into the physical and mechanical properties of materials used in many trades.

(3) Investigations useful to a trade which has no fixed centre, but is widespread over the country.

Or again, (4) a central laboratory will be of service as a means whereby information as to large questions of general interest, investigated either at the central laboratory itself or at the local special laboratories, may be circulated and time saved by placing at the disposal of any special laboratory requiring them the results obtained elsewhere.

Let me take these heads more in detail. I will postpone the consideration of No. 1—standardisation problems—to my next lecture. It is sufficient to remark here that the work already done in this direction has been very great, and to point out that unification of standards used in various trades is highly desirable, and can be secured only by the existence of a central standardising institution working in close co-operation with local institutions.

Turning then to (2)—investigations into the properties of materials used in many trades—the work done on light alloys affords a good example of this, work for which the British Aluminium Co. has recently shown its appreciation by sending a generous donation of 500*l.* to the funds of the laboratory.

Or, again, the following are a few of the problems which it has been recently stated need solution to satisfy the needs of one important industry:—

(1) An investigation into the physical properties of alloy steels.

(2) An investigation into the conditions affecting the flow of liquid fuel through an orifice with reference to: (*a*) proportions of orifice; (*b*) temperature of fuel and air; (*c*) viscosity of fuel.

(3) An investigation of the stress distribution in irregularly shaped members—crankshafts and the like.

(4) An investigation into the wear of bearings.

(5) Investigations into the material suitable for valves, cylinders, and other parts of internal-combustion engines.

(6) The efficiency of radiators for such engines.

(7) An investigation into the cause of the lubricating properties of oils with the view of framing a specification for such oils.

It is obvious that the results of all these investigations, while of special importance to the automobile industry, are of great interest to others. Any of them could go on in a properly equipped laboratory, while it is clear that to carry out many a very complete physical and, in some cases, chemical equipment is needed.

And that leads to another very important point. A special laboratory, if it is to be really of use, must be complete. Many of the investigations just indicated involve thermal and electrical measurements of high accuracy. Elaborate apparatus is involved and a skilled staff to use it. These conditions can be satisfied only if the laboratory possesses a large and varied staff, capable of advising on each special point as it arises, and the necessary outfit of delicate and expensive apparatus. In many instances the difficulty lies in the development of the method of measurement and the calibration and standardisation of the apparatus employed rather than in the actual experiments.

Or to take another instance. There have been some conferences lately with regard to research in refractories, and it was clear that there is much work to be done and ample opportunity for the development of research in special laboratories in close contact with the industry, whether at Sheffield, Middlesbrough, or South Wales, for steel-making and other metallurgical processes, or in the Potteries for the china and earthenware trades. It was clear, too, that there was much work which could best be done at a central institution such as the National Physical Laboratory. Such work, for example, would embrace, among other things, an investigation into many of the physical and other properties of refractories.

As instances of (3)—investigations useful to a trade which has no fixed centre—I may give the following:—

(1) A research has been in progress for some time at the laboratory into the heating of buried cables carrying electric currents. In connection with the Wiring Rules Committee of the Institution of Electrical Engineers much has been done to determine the temperature to which the cables used in house wiring are raised in various circumstances, and to fix the safer currents to be used in each case. Our knowledge of the temperature reached in cables when buried in the ground is very scanty and somewhat conflicting; much depends on the nature of the covering used to protect them, and possibly something on the nature of the soil. Cables laid in ducts, again, differ from those protected merely by the ordinary forms of lead or other covering, and yet the life of the insulation depends in great measure on the temperature reached when the current is flowing, and thus regulates the carrying capacity of the cable. Thanks to the co-operation of supply authorities in many parts of the country, much valuable information has been collected, and, though the research at the laboratory proceeds but slowly, results of great importance are being obtained. Such a research needs large appliances, and currents up to eight or ten thousand amperes will be employed. It needs also the resources of a fully equipped physical laboratory in order to measure accurately the temperature differences due to varying conditions; when complete it will be of value to all supply companies. This is true of many other electrical tests and experiments; the results are of wide application; it is desirable that they should be widely published.

(2) The building trade offers another example of this kind. Brick and stone, wood and iron, have been used for long, and their properties when employed for building construction are generally well known. This is less true of other more modern materials—ferro-concrete, for example. There are rules—based no doubt on the best experience available—for estimating the strength of beams, columns, and floors, but there is much scope for inquiry. Accordingly, at the instance of Sir John Cowan, of the firm of Messrs. Redpath, Brown, and Co., who is bearing the expense, apparatus is being built to test columns up to 15 ft. or 20 ft. in length, and floors of considerable size. War conditions again are interfering, but the work is progressing slowly and must be done. There are other materials besides ferro-concrete urgently calling for examination. Nor is the strength of the materials the only factor to be considered. Materials transmit heat in very varying amounts, and the comfort of a house, to say nothing of the cost of living in it, will depend on whether it is possible easily to keep it warm in winter and cool in summer.

(3) Recently we were asked to compare the heat losses from two enclosures exactly alike in all respects, except that the one was roofed with corrugated iron, the other with some preparation of asbestos. It was found that the latter cooled 20 per cent. faster than the former; the loss of heat depends, in part on the conductivity

of the material, in part on the emissivity of its surface, and the superior emissivity of the asbestos sheet more than made up for its inferior conductivity. In this connection it is clear there is much to be done, and for such work a central laboratory, with proper equipment, is the most suitable place. Arrangements are in progress by which it is hoped many of these questions will be thoroughly investigated.

Little need be said as to the fourth section of the work suggested for a National Industrial Research Laboratory.

The importance of the collection and dissemination of information on matters connecting industry and science is clear. At a central laboratory much of the information will be to hand; the accumulated experience of the staff, their knowledge of the work done in the sectional laboratories, their appreciation of the bearing on industry of inquiries in the region of pure science, are all valuable assets, and a proper organisation only is needed—by means of a bulletin or in some such way—to circulate their information where it is most wanted.

There is ample room for a central laboratory without trenching in the least on the spheres of the local sectional institutions. If the Department of Scientific and Industrial Research is to carry out effectively the work it contemplates, such a laboratory is essential, and my hope is that the National Physical Laboratory may develop into such an institution in close connection, through the Department, with local laboratories throughout the country.

One word in conclusion. The workman is worthy of his hire. In the past the scale of pay has certainly not been extravagant, and there is no call for extravagance in the future, but the remuneration offered must be sufficient and the conditions of work fair. Much has been written lately as to the inadequate remuneration of scientific workers, whether teachers or the expert staff of laboratories and factories, and it is realised, I trust, that the time has come to change this for men and for women alike. To-day there is a great demand for scientific workers, and while, as in other walks of life, commercial life must offer greater prizes than Government service, it is essential, if the necessary work is to be done and the workers are to be retained, that the emoluments of technical posts under Government, and the conditions attached, should be as good as those of the regular administrative staff of the Civil Service. This must apply not merely to the heads of the various institutions, but also to the rank and file on whose work success depends. This point I need not labour here, but in pressing it I feel confident I shall have the support of all who appreciate the importance of science to the nation.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—During the present term two research fellowships, in medicine and science respectively, have been founded. The Faulds fellowship in medicine is of the annual value of 200*l*., and is tenable for three years. It will be awarded to a recent graduate who has shown capacity for original investigation. He will be required to devote himself to research in some branch of medical science approved by the Senatus, and will not engage in private practice. He may be authorised or required to spend a year of his tenure away from Glasgow. The Ferguson fellowship in applied chemistry is of about the same value. It will be awarded to a bachelor of science who has taken chemistry as a subject for his honours degree. He may carry on his fellowship work either in the University itself or in the affiliated Royal Technical College.

LEEDS.—The thirteenth annual report, which has just been issued, for the year 1916–17, contains a record of great activity in most of the departments of the University. Three aspects of the work have exceptional significance. The first of these is in the sphere of applied science, particularly in connection with the textile, dyeing, leather, and fuel industries. As a result of conferences organised and held in the University, a committee has been formed by members of the woollen and worsted industries in the West Riding for the purpose of developing research. In the colour chemistry department important research work has been carried out on behalf of British Dyes, Ltd.; a laboratory has also been placed at the disposal of Messrs. L. B. Holliday and Co., for research work, in charge of their head chemist; conferences have been held with the Leather Trades' Federation for developing instruction and research in that industry, whilst in the fuel department investigations are being made into the comparative efficiency of different grades of gas under the direction of a Joint Committee of the University and the Institution of Gas Engineers. As regards the second aspect of the work, members of the staff of the agricultural department have undertaken official responsibilities in connection with the food supply of Yorkshire. As to the third, the new departments of Russian and Italian language and literature, which owe their inception to the generosity of Sir James Roberts, Lord and Lady Cowdray, and Mr. Walter Morrison, have been organised. The number of students shows a slight decrease since the previous session, and although some of the advanced classes and technical departments have been depleted of men students owing to the war, the number of first-year students is maintained. The casualty lists include 462 names, of which 176 have been killed, died on active service, or reported missing. Military distinctions have been conferred upon ninety-nine members of the University.

LONDON.—The Senate has resolved to institute degrees in commerce for both internal and external students, and in this connection to accept with thanks an offer from Sir Edward Stern of 2000*l*. to found a scholarship for the promotion of the study of that subject.

The following doctorates have been conferred:—*D.Sc. in Biochemistry*: Mr. J. C. Drummond, an internal student, of the East London College, for a thesis entitled "A Comparative Study of Tumour and Normal Tissue Growth." *D.Sc. in Experimental Psychology*: Miss I. B. Saxby, an internal student of University College, for a thesis entitled "Some Conditions affecting the Growth and Permanence of Desires."

Dr. H. Wildon Carr has been appointed by the Senate professor of philosophy at King's College.

SOME years ago, Lord Haldane, the protagonist of the university movement, pictured the United Kingdom as partitioned into provinces, in each of which the various grades of primary and secondary schools, technical schools, and colleges are to be held together and co-ordinated by a university. His scheme has been derided by some as an "educational heptarchy," but, provided the several kingdoms are united states, admitting the overlordship of the Minister of Education, their limited autonomy will be the surest guarantee of efficiency in administration. The jealousies of technical institutes and municipal colleges, one of another, and all of the university college, if there be one, would subside in patriotism to the university—*i.e.* to the province. The North, the Midlands, and the West of England are already portioned out; the needs of the South have yet to be provided for. Owing to the absence of large centres of population, the problem of how this is to be done is exceptional. Lord Haldane imagined a university of the South, at Southampton, the natural focus, and one farther west. A movement is now on foot for securing the establishment of the latter, to serve the needs of Cornwall, Devon, and parts of Dorsetshire and Somersetshire. In many ways this corner of England has its own peculiar interests. It comprises the great port of Plymouth, mining centres, fisheries, and large areas devoted to agriculture and orchards. The Royal Albert Memorial College at Exeter is doing excellent work of a university standard, the technical institutes of Plymouth and Devonport are fitted for research in shipbuilding, the Marine Biological Association's laboratory for problems connected with fisheries, the old-established School of Mines at Camborne for investigation of the metalliferous rocks and industries, the Seale-Hayne College in agriculture; but possibly the strongest of all reasons for multiplying universities is the urgent need for teachers qualified by intellect and training to make a success of the new Education Act to which we are looking forward, with its enormous extension of secondary and technological education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 14.—Sir J. J. Thomson, president, in the chair.—A. W. **Conway**: An expansion of the point-potential. The general solution of the equation $C^2\nabla^2\psi=\ddot{\psi}$, which is infinite at the origin, is of the form $f(Ct\pm r)/r$. This is infinite to the first degree. Referred to a different origin, a known expansion gives the series $\sum Y_n U_n$, where Y_n is a spherical harmonic and U_n is a certain function of t and of the distance to the new origin. This is a generalisation of the Legendre expansion of the inverse distance. In the paper the potential scale or vector of a moving point-charge is expanded in a similar series of spherical harmonics, the only restriction on the motions of the point-charge and of the origin being that the speed of the former must be less than that of light.—E. G. **Bilham**: The lunar and solar diurnal variations of water-level in a well at Kew Observatory, Richmond. The mean solar and lunar diurnal inequalities have been computed from two-hourly measurements of the Kew Observatory water-level records over a period of two years. Results are given for each month, for the year, and for groups of months, representing high, intermediate, and low levels. Both the lunar and solar diurnal ranges are found to be largely dependent on the level of the water, high levels being associated with large diurnal range. In a paper recently communicated to the society it was shown that a similar relation exists between the mean level and the sensitiveness to the effects of barometric pressure. There are well-marked lunar and solar semi-diurnal oscillations throughout the year, the amplitude varying with the level in a manner similar to the diurnal range. In both cases the phase also varies with the level, the effect being most pronounced in the lunar results. The times of occurrence of the maxima become later as the water-level falls. In comparison with the total oscillations in the neighbouring River Thames, the well shows larger solar diurnal movements than were to be anticipated from the magnitude of the lunar oscillations. If, however, allowance is made for the effects of the solar diurnal variation of barometric pressure, the residual effects attributed to the solar tides are of the expected order of magnitude.

Faraday Society, February 14.—Prof. C. A. Edwards in the chair.—H. **Etchells**: Applications of electric furnace methods to industrial processes. The remarkable growth of electric furnace industries during the war was due not only to the greater output demanded, but also to the fact that the electric furnace enabled us to use raw materials formerly considered inferior for the quality of product desired. A plea was made for the greater development of the resistance furnace, which, from the electrical point of view, was ideal. In the author's opinion, the electric furnace is not fulfilling its highest function in the foundry when used for simply melting steel scrap, to turn out an unrefined product on an acid lining. Typical wave-form diagrams of the chief types of furnace were shown, and considerable emphasis was laid on the steadiness of load produced by the buffering effect of bottom electrode furnaces. The unsatisfactory performance of refractory lining materials at present in use was commented upon, and the author stated it as his belief that satisfactory linings would not be available until electrically fused refractories were put on the market.—J. **Bibby**: Electric steel refining furnaces. A system is described by which a four-phase furnace with a bottom electrode, such as is called for as furnaces get larger, can be run on the ordinary three-phase supply system.—A. P. M. **Fleming** and F. E. **Hill**: Electric furnace control. An important feature of electric furnaces is that by suitable control the temperature can be accurately and quickly regulated. The paper sets forth the general principles on which such control is based.

Royal Microscopical Society, February 20.—Mr. J. E. Barnard, president, in the chair.—Col. H. E. **Rawson**: Illustrations of photo-synthetic action induced in living cells. The author exhibited *Tropaeolum majus*, in which changes of colour and structure were produced by a system of selective screening from an English sun at selected intervals of daylight. Low sun of the early morning fostered the yellow colouring matter, and the highest sun of midday the violets, blues, and purples, while middle sun stimulated the reds. The colour of the foliage also changed, as well as the lobing of the leaves. The scent of the flowers varied with the colour. Changes of structure also appeared, which became identified with low, middle, and high sun, and could be repeated at will. Flowers grew with six, seven, and eight petals, instead of the normal five, and their shapes were altered. Spurs were formed to extend a petal instead of a sepal, and the number was increased to four. Colour changes depended upon the form, size, and number of the epidermal papillæ, the turgidity of the living cells, and the concentration of their contents. In the leaf-division of *T. tuberosum* a precipitation of the cell contents was first observed, by which the cord conveying the nutrition to the margin became blocked.—F. I. G. **Rawlins**: The technique of the vertical illuminator. It was found unnecessary to use objectives in special short mounts with the vertical illuminator up to and including one-sixth powers, provided the objectives were corrected for work on uncovered objects. Levelling of the specimen was best done by pressing the specimen face downwards upon a piece of plate glass with a small quantity of plasticine on a common 3-in. by 1-in. slip. The latter was rested on the two edges of an accurately cut ring, and held there until the preparation had become embedded in the plasticine. For preserving metal specimens a thin coating of a concentrated solution of guncotton in amyl acetate was recommended—as a preventive against rust. This was dropped on to the surface, and the section tilted until the drop found its own level, and set quite evenly to a thin layer, sufficiently transparent for use with a one-sixth objective. The varnish must not be applied with a brush, or ridges resulted which gave brilliant interference colours when viewed under the microscope.—J. **Ritchie**: Acetone as a solvent for mounting media. The author claimed for his medium that it cleared specimens from various grades of alcohol direct without the use of essential oils. It did not cause a precipitate or any uneven shrinkage of the tissues of specimens where these had been properly fixed. It did not affect stains such as borax or lithium carmine, Van Giesen's, hæmatoxylin, Jenner, Leishman, or Giemsa stains.

Röntgen Society, March 5.—Capt. G. W. C. Kaye, president, in the chair. — C. R. C. **Lyster** and Dr. S. **Russ**: A biological basis for protection against X-rays. In this contribution the study of the protection of X-ray operators was approached from a somewhat different point of view from that usually adopted. In previous investigations the materials have generally been tested to ascertain what fraction of the incident rays are transmitted, while in this case an attempt was made to measure the total quantity of radiation received by the operator during, say, a day's work under normal conditions. For this purpose the operator carries a photographic plate upon his person, and at the end of the period under consideration the plate is developed. The density of the resulting image is compared with that of another plate termed the "biological basis plate," which has been exposed under standard conditions of radiation. A preliminary investigation enables the harmful effects of the standard source of radiation to be determined, and thus gives a meaning to the indication of the biological basis plate. Radium forms a useful source of radiation for practical purposes after the initial tests have been made, and it overcomes difficulties in the employment of an X-ray tube as a constant source. The effect of hard and soft radiation (12-in. spark to 2 in.) on the photographic plate was fully investigated, and it was concluded that for the same ionising effect the hard and soft rays produced about the same photographic effect; the effect, however, varies with different makes of plates, and in consequence all comparisons must in practice be made with the same variety.—H. C. **Head**: A mobile X-ray unit. A detailed description illustrated by numerous photographs was given of a motor X-ray unit recently designed and constructed for use in Mesopotamia, etc. The Austin chassis was chosen on account of its low load line, and the body was divided into two portions, one to serve as dark-room, while the other contained the X-ray equipment. In operation a tent is erected at one side of the car, with the result that it is unnecessary to remove the coil or switchboard for use. Electric current is supplied from a dynamo run off the motor engine and from a small battery of accumulators, and is sufficient to render possible the production of short-exposure radiographs.

Geological Society, March 6.—Mr. G. W. Lamplugh, president, in the chair.—J. F. N. **Green**: The igneous rocks of the Lake District. The author first directed attention to some of the manuscript 6-in. maps of the Lake District prepared nearly fifty years ago by the Geological Survey, and pointed out that, although undoubtedly most accurate, they differed greatly in the volcanic area from his own. He suggested that the reason was that there was a fundamental difference in the classification of tuffs and lavas. A large proportion of the Lake District rocks were brecciated, and had been supposed to be altered tuffs. With the unbrecciated rocks into which they passed they had been mapped as ashes. Recently, manuscripts had been found in the possession of the Geological Survey proving that Aveline, whose maps were extraordinarily accurate and detailed, had anticipated by thirty years the author's separation from the volcanic rocks of the basal beds of the Coniston Limestone Series. When re-mapped on this basis, the Borrowdale Series appeared as a simple and regular sequence, strongly folded, and cropping out in long bands.

Physical Society, March 8.—Prof. C. H. Lees, president, in the chair.—E. A. **Owen**: The asymmetrical distribution of corpuscular radiation produced by X-rays. (1) The ratio of emergent to incident corpuscular radiation in the case of the two salts, potassium bromide and silver nitrate, has been investigated, when the exciting X-radiations were the characteristic radiations of copper, bromine, silver, and tin. (2) The ratio has the same value whether the salt is in the wet or in the dry state. (3) The value of the ratio was found to be approximately the same for each two of the salts, and is equal to 1·17. This is approximately the same figure as that found by other observers in the case of the metals, gold and silver.—Prof. C. H. **Lees**: "Air standard" internal-combustion engine cycles and their efficiencies. It is well known that the efficiency of an air standard internal-combustion engine working through a cycle bounded by two adiabatics, and either two isothermals, two constant volume lines, or two constant pressure lines, is given by $1-(1/r)^{\gamma-1}$, where r is the compression ratio and γ is the ratio of the two specific heats of air. In the present paper it is shown that the efficiency is given by the same expression if the cycle is composed of two adiabatics and two curves $pv^{\alpha}=A$, $pv^{\alpha}=a$, where α has any positive or negative value, and A and a are constants. Since α may be chosen so that any explosion curve may be followed as closely as desired by short lengths of α curves, a cycle can be drawn with the above efficiency and any prescribed explosion curve. The ratio of the efficiency of a cycle with prescribed explosion and exhaust curves to that of the cycle so drawn is shown to be the ratio of the two areas on the indicator diagram. The thermal efficiency of a cycle with prescribed explosion and exhaust curves is therefore readily found.

Optical Society, March 14.—Mr. S. D. Chalmers, vice-president, in the chair.—T. **Smith**: The detection of ghosts in prisms. Ghosts in prisms are caused by reflections other than those which form the principal image. They are apt to be more serious than those in lenses, inasmuch as a single additional reflection may cause a ghost in a prism, while at least two are necessary in a lens. Moreover, in lenses the ghost-producing reflections occur at unsilvered surfaces at small angles of incidence, but in prisms the surface may be silvered or the ghost may be produced by total internal reflection. Every possible way in which a ghost can arise in a prism may be determined by a suitable development of the prism, or of a section of the prism, on a plane. If a diagram is drawn showing all possible positions of a prism derived from a given initial position, the entire path of any ray within the prism is represented by a straight line, and the deviation of the ray is of the constant type if the ray has crossed an even number of lines representing reflecting surfaces, and of the variable type if the number is odd.

Royal Meteorological Society, March 20.—Sir Napier Shaw, president, in the chair.—Dr. J. S. **Owens**: The measurement of atmospheric pollution. The need for exact measurements of suspended impurities in the air was explained. The era when a harmless gas like carbon dioxide was taken as a measure of impurity was rapidly giving way to a recognition that the really important thing to measure was suspended dust and dirt. It was shown that the latter connoted great waste of human life, and also of fuel, light, and other important modern needs. As showing the kind of air city dwellers were sometimes obliged to breathe, Dr. Owens gave figures for deposits from the air for one year, April to March, at the following places:—Oldham, 1915–16, 950 tons per square mile; Manchester, 1915–16, 635 tons; London, 1915–16, 453 tons; Sheffield, 1914–15, 395 tons; Malvern Wells, 1915–16, 56 tons. He stated that there was evidence of a general reduction of atmospheric impurity during the winter of 1916–17 as compared with the preceding one, probably due to reduced consumption of raw coal. Mention was made of certain problems awaiting solution, such as the relation of impurity to wind and distance from source, also to incidence of disease. Does smoke in the air reduce or increase the number of bacteria? What is the vertical distribution of suspended matter and the selective power of rain or snow in bringing down impurity?

MANCHESTER.

Literary and Philosophical Society, March 5.—Mr. W. Thomson, president, in the chair.—E. L. **Rhead**: The corrodibility of cast-iron. The paper dealt with the effects of the impurities in producing during the solidification of the metal various solutions, in which the impurities were concentrated. This was especially the case with the phosphide. The concentration depended on the lower melting point of the solution thus formed. Reference was made to the production of graphite. Specific instances in which the failure of cast-iron vessels was due to the increase in volume resulting from the corrosion, and the influence of the structure due to the segregation and coarse graphite, were dealt with and specimens shown. Attention was also directed to the high silicon iron now used for chemical plant, and segregation was shown to take place to a marked extent.

PARIS.

Academy of Sciences, March 4.—M. Paul Painlevé in the chair.—The president announced the death of Prof. Blaserna, correspondant of the Academy for the section of physics.—A. de **Gramont**: The ultimate rays of great sensibility of columbium (niobium) and zirconium.—C. **Guichard**: A particular class of curves several times isotropic.—W. **Kilian**: The fauna of the Hauterivian stratum in the south-east of France.—Mr. Amundsen was elected correspondant of the Academy for the section of geography and navigation in succession to the late Dr. Albrecht.—J. F. **Ritt**: The repetition of rational functions.—M. **Valiron**: Demonstration of the existence, for integral functions, of paths of infinite determination.—M. **Doyère**: Remarks on the resistance to motion of geometrically similar vessels.—J. **Rey**: Entropy diagram of petrol.—Sir R. **Hadfield,** C. **Chéneveau,** and Ch. **Géneau**: The magnetic properties of manganese and of some special manganese steels. Manganese, when freed from occluded gases, is paramagnetic. Data are given for manganese-carbon steels, and steels containing, in addition to these two elements, nickel, tungsten, chromium, and silicon.—A. **Valeur** and E. **Luce**: The reduction of the CH_2I group joined to nitrogen.—G. **Fouque**: Dicyclohexylamine, its solid hydrate and alcoholate.—P. **Russo**: Geology of the plain of El Hadra, western Morocco.—J. **Repelin**: New species of the genus Entelodon.

March 11.—M. Paul Painlevé in the chair.—Ch. **Lallemand** and J. **Renaud**: The substitution of civil time for astronomical time in nautical almanacs. At sea sailors use civil time, but for their observations make use of tables where astronomical time is employed, and it is desirable that this possible source of confusion should be removed. Both the French and British Admiralties considered the proposal favourably, and the volume of the "Ephémérides nautiques" now in preparation (1920) will have civil time substituted for astronomical time.—W. **Kilian**: New remarks on the fauna of the Hauterivian, Barremian, Aptian, and Albian strata in the south-east of France.—M. Tilho was elected a correspondant for the section of geography and navigation in succession to the late General Gallieni.—Tr. **Lalesco**: A point of the theory of nuclei capable of symmetry.—M. **Brillouin**: Biaxial media.—F. **Cloup**: Tempering and work hardening in carbon steels.—M. **Travers**: The colorimetric estimation of tungsten. The method is based on the reduction of tungstic acid by titanous chloride to a blue oxide, which, under certain conditions, remains in colloidal suspension. The reaction cannot be applied if vanadium, phosphorus, or molybdenum is present.—J. H. **Sinclair**: The age of the sandstones of French Guinea.—L. **Gentil**: The age of the strait connecting the Mediterranean and the Atlantic through Morocco in the Miocene epoch.—A. **Guébhard**: Remarks on the "écorce résistante."—G. **Reboul**: A method of predicting barometric variations.—J. **Amar**: The law of cicatrisation of wounds. The number of factors is so large, and the phenomenon so complex, that it is doubtful whether any attempts at mathematical expression can be successful.—B. **Geslin** and J. **Wolff**: New observations on the degradation of inulin and "inulides" in the root of the chicory.

BOOKS RECEIVED.

The Theory of Electricity. By G. H. Livens. Pp. vi+717. (Cambridge: At the University Press.) 30*s.* net.

Electricity Meters: Their Construction and Management. By C. H. W. Gerhardi. Second edition. Pp. xx+504. (London: Benn Bros., Ltd.) 15*s.* net.

Stanford's War Maps. No. 27: Europe and Northern Asia. (London: E. Stanford, Ltd.)

Some Problems of Modern Industry. By W. L. Hichens. Pp. 61. (London: Nisbet and Co., Ltd.) 6*d.* net.

Proceedings of the Aristotelian Society. N.S. Vol. xvii. (London: Williams and Norgate.) 12*s.* 6*d.* net.

CONTENTS. PAGE

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, APRIL 4, 1918.

GOURSAT'S "COURSE OF ANALYSIS," AND OTHER MATHEMATICAL WORKS.

(1) *A Course in Mathematical Analysis. Differential Equations.* Being part ii. of vol. ii. By Prof. E. Goursat. Translated by Prof. E. R. Hedrick and Otto Dunkel. Pp. viii+300. (London: Ginn and Co., n.d.) Price 11s. 6d. net.

(2) *Finite Collineation Groups, with an Introduction to the Theory of Groups of Operators and Substitution Groups.* By Prof. H. F. Blichfeldt. Pp. xi+194. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1917.) Price 1.50 dollars net, or 6s. net.

(3) *Introduction to the Calculus of Variations.* By Prof. W. E. Byerly. Pp. 48. (Mathematical Tracts for Physicists.) (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1917.) Price 3s. 6d. net.

(1) THE American translation of Prof. Goursat's "Course of Analysis" will be welcome to those who may be unable to read the original easily. The present instalment covers ground in which the author is an acknowledged adept, and it illustrates his remarkable power of illuminating obscurities and giving charm to discussions which, although unavoidable, are apt to be dull. Thus his chapter on existence theorems is not only a model of rigour, but actually entertaining as well; § 30, on the Cauchy-Lipschitz method, is most instructive, and illustrates the value of a diagram when properly used—not as a vehicle for a sham "intuitive proof," but as an image corresponding to a set of analytical data and deductions. Geometrical imagery of this kind is frequently used throughout, and with the happiest results—especially, it seems to us, in the part dealing with partial differential equations of the first order.

There are some features of special interest in the earlier part, which deals with ordinary equations. As an isolated gem we may note the integration of Euler's equation (pp. 23–28), especially the method which leads to Stieltjes's form of solution. The third part of the chapter on linear equations gives a capital summary of the main results obtained by Fuchs, Picard, and others; illustrations are afforded by the hypergeometric series and Lamé's equation. In the chapter on non-linear ordinary equations of the first order there are a number of valuable results, especially those based on Briot and Bouquet's researches as to equations of the form $(dy/dx)^n = R(y)$, where $R(y)$ is a polynomial in y. Here we have a list of all the cases of this type which can be satisfied by a one-valued function of x, and also—which is more important—a clear proof that there are no others.

Next comes a section on singular solutions, and an Englishman cannot help feeling surprised to find no reference to Cayley here (or, indeed, anywhere else in the volume). Readers should notice the last paragraph of § 71; the point is that, if we equate the p-discriminant to zero, the *normal* meaning of the result is a cusp-locus (or tac-locus, or both) which does *not* yield a singular solution; the reason that mathematical students so often obtain a singular solution from the p-discriminant is that so many equations of the type $f(x, y, p)=0$ are made up by eliminating a constant c from the equation of a set of algebraic curves $\phi(x, y, c)=0$, which have an envelope.

The discussion of Charpit's method seems to us to be as good as any that can be put into a text-book. What makes it so unusually clear is that the author proves in a separate article (§ 81) that the condition for the compatibility of $f(x, y, z, p, q)=0$, $\phi(x, y, z, p, q)=0$, $dz=pdx+qdy$, is $[f, \phi]=0$, where the symbol on the left is that introduced by Jacobi. Later on we have discussions of Cauchy's method (pp. 249–64) and of Jacobi's method (pp. 265–78). It should be added that there is a very brief account (pp. 86–98) of Lie's theory of transformation-groups.

From time to time the author pauses to make a general remark on this or that aspect of his subject, and these *obiter dicta* deserve the most careful attention. For instance: "Although this reduction is not, in many cases, of any practical utility, it nevertheless possesses great theoretical interest, for it enables us to determine just how difficult the problem is" (p. 214). Most text-books on differential equations are very misleading, because they give the student the impression that the subject is very much better understood than it really is. The most simple-looking partial differential equations may baffle the most eminent mathematicians, and it would scarcely be too much to say that there is no extensive *theory* of differential equations except for linear ordinary equations the coefficients of which are of certain specified types. This assertion is not so paradoxical as it looks; all the fundamental functions of analysis (*not* of arithmetic) can be defined by very simple ordinary differential equations; for instance, $\exp(x)$ is that solution of $dy/dx=y$ which has the value 1 when $x=0$. All the properties of $\exp(x)$ can be deduced from this, and the whole of analytical trigonometry is then only a corollary.

(2) Prof. Blichfeldt collaborated with Messrs. G. A. Miller and L. E. Dickson in a work on finite groups reviewed in these columns on November 23, 1916 (vol. xcviii., p. 225). The present work, dealing with collineation groups, so far departs from abstract group-theory as to choose a special imagery, or, if you will, a drapery, for the sets of abstractions considered. Every group may be imaged as a substitution group; not every group can be represented by a collineation group. So Prof. Blichfeldt has restricted his field of inquiry, and deliberately tried not to use abstract group-theory any more than he can help. For the purpose he has in

hand this has undoubted advantages. One of these is that collineation groups form a very extensive family, which admits of geometrical or quasi-geometrical interpretation. (This book has no figures, but the reader should make illustrative figures and models for himself, and think out the arguments in as geometrical a form as possible.) So far as we can judge, the treatment is sound, though it involves some rather artificial arrangements; *e.g.* chap. ii. contains a good deal of *abstract* group-theory, and so far as we can see, the term "group" in its technical sense has not been anywhere defined, and on p. 31 it seems to be confounded with "set" and "class," which, if meant, is very unfortunate.

The discussion goes as far as linear groups of four variables; there is a chapter on group-characteristics (mainly, of course, after Frobenius and Burnside); there are numerous references, and a moderate number of examples. We hope the book will have a wide circulation; every advance in the theory of groups is bound to result in an advance in many other branches of mathematics.

(3) Prof. Byerly's tract will be useful to those who are interested in the classical problems of the brachistochrone, etc., and also, it may be hoped, to physical students engaged in their first struggles with the Hamiltonian equations, least action, least constraint, and so on. So far as we know, a really good elementary treatise on the calculus of variations has yet to be written; meanwhile, such an outline as this is better than many big and pretentious productions. G. B. M.

MEDICAL HISTORY AND SCIENTIFIC METHOD.

Studies in the History and Method of Science. Edited by Dr. Charles Singer. Pp. xiv+304. (Oxford: At the Clarendon Press, 1917.) Price 21*s*. net.

DURING the last ten years there has been a notable revival of the study of the historical development of medicine by the scientific methods which have been applied to other branches of history. In this country there has been no more active worker than Dr. Charles Singer, who for some time has been employed in unearthing for convenient reference the medical historical treasures of the Bodleian Library. The present volume is the outcome of some of the studies of Dr. Singer and his co-workers, and must be regarded as a notable contribution to certain branches of medical history and evolution. The book is splendidly got up, and in addition to forty-one plates, many of which are excellently reproduced in colour, there are large numbers of figures in the text. It is almost remarkable that such a work should make its appearance in the fourth year of the war, and especially at the moderate price of 21*s*.

The text contains seven articles and studies, most of them of immediate historical interest. Dr. Singer himself contributes two of these, the first a very learned account of the scientific views and visions of Saint Hildegard, the German religious mystic of the twelfth century. From the extensive literature which has collected round this complicated personality, Dr. Singer has managed to create a study of great interest, and has dealt in particular with her views on anatomy and physiology. In his second essay, "The 'Anothomia' of Hieronymo Manfredi," he has dealt with the hitherto unknown account of the body written in manuscript by Manfredi at the end of the fifteenth century. As he points out, this is the most complete post-medieval account of anatomy until we come to the first of the anatomists, Berengario da Carpi, who published his work in 1521. Dr. Singer publishes the whole of the Italian manuscript, and leads up to it with a masterly account of the Early Renaissance anatomy, profusely illustrated.

In his "Blessing of Cramp Rings" Dr. Raymond Crawford writes exhaustively of a treatment of epilepsy which was in vogue for hundreds of years. Although it is often regarded as springing up in the time of Edward the Confessor, it cannot be denied that the idea of applying some kind of constriction to inhibit the convulsions of epilepsy can be traced back to classical times.

One of the most interesting studies is Dr. E. T. Withington's on "Dr. John Weyer and the Witch Mania." Herein are traced the origin and development of the most extraordinary superstition which has ever disgraced the human mind, and led to the sacrifice and mutilation of vast numbers of unfortunate human beings even so late as the seventeenth century. It is particularly remarkable that the witch mania should have reached its height at a time when the Renaissance was in full tide and learning was opening men's minds. Dr. Withington considers that at least two causes co-operated for the development of this madness, viz. the development of heresies and the increasing prominence given to the supposed operations of the Evil Spirit, a doctrine supported by the pronouncements of Pope Innocent VII. in 1484. It was then that the Church called upon the civil powers to exterminate witches, and Europe rang with the cries of the innocents perishing daily on the rack and at the stake. Amidst all the ghastly shambles we have the vision of Dr. John Weyer, of Arnheim, trying to stem the tide of this mania, but with ill-success. Although his great work was published in 1563, the practice of torturing witches progressed or increased, and only finally began to die down in the seventeenth century, being finally extinguished in England so late as the beginning of the eighteenth century.

Mr. Reuben Levy contributes an article on "The 'Tractatus de causis et Indiciis morborum' attributed to Maimonides." This work was said to be by the Jewish philosopher, and was considered to be his chief claim as a medical writer. By a complete examination of the only manuscript known, Mr. Levy proves that it was by another writer altogether, and thus clears away an error.

In his essay on "Scientific Discovery and Logical Proof," Dr. F. C. S. Schiller argues at great length that one of the main obstacles to scientific progress has been the analysis of scientific procedure which Logic has provided, and he pleads that it should abandon its pretensions to rigour and conclusiveness. A philosophical treatment is also adopted by Dr. J. W. Jenkinson on "Vitalism." Dr. Jenkinson was a distinguished embryologist, who, although forty-three years of age, took his commission and fell only ten days after his arrival at the Gallipoli Peninsula.

MILK PRODUCTS.

Manual of Milk Products. By Prof. W. A. Stocking. Pp. xxvii+578. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 10*s*. 6*d*. net.

THIS book is one of the "Rural Manuals"—a series edited by Prof. L. H. Bailey. It is a very complete treatise on all matters connected with the dairy industry. The general scheme of the book is to bring together in one volume the most recent and trustworthy information upon milk and milk products. In pursuance of this object, Prof. Stocking has quoted the writings of specialists in the various branches, so that the student and the practical man are in a good position to learn what is known on those aspects of dairying which are to them of the greatest interest.

The preliminary chapters deal with the process of milk secretion, and the evidence in support of the various theories is given. The much-debated question as to the effect of food upon the quality of milk is discussed in chap. iii., as are other factors which may also have an effect—particularly upon the fat-content of milk. Owing to the fact that the standard method of estimating fat in the United States is by means of the Babcock test, the chapter on milk testing is scarcely so useful to the British reader.

Of late years the American dairy trade has made great advance in the provision of a supply of clean milk for public consumption. In New York there are three grades of milk and cream, and the regulations governing the sale are quoted, as are also the score cards used in connection with milk inspection. One chapter is devoted to certified milk, which is used almost exclusively for the feeding of infants, the cost of production preventing milk of this class being available for any large number of the general community, much as it is desirable that the high standard of purity should be attained for larger quantities of milk. It is clear, however, that the educational value of the efforts now being made to get a clean milk supply must favourably influence the trade as a whole.

The making of butter and cheese occupies about half the space in the book, and full particulars are given of all the necessary appliances and machinery together with details of operations.

There is no doubt that, with the increased demand for cheese, more milk will be used for the production of the latter important article of food in the future. The standard makes of English cheese, such as Cheddar and Stilton, are dealt with, the former variety in considerable detail, as it has become the chief cheese made in America. Working directions are given for making a large number of other cheeses, such as Gouda, Edam, Camembert, Neufchâtel, cream, etc. There is a chapter dealing with the part played by bacteria in dairying, but this section would have to be supplemented by a knowledge of dairy bacteriology if the best use were to be made of it.

OUR BOOKSHELF.

The Improvement of the Gregorian Calendar. By Alexander Philip. Pp. 30. (London: G. Routledge and Sons, Ltd., 1918.) Price 1*s*. 6*d*. net.

OUR present calendar has many inconveniences: the author's recommendations are limited to the correction of the most serious. Notably, August should give a day to February, reversing the reprehensible change attributed to Augustus. If the day were removed from August in one year and added to February in the following year, no alteration would be involved in the Easter tables. Also the leap-day should come at the end of a year; its present position causes many complications. This might be managed, the author suggests, by beginning the year on March 1. He points out the desirability of making each quarter exactly thirteen weeks. He would have one day in common years and two in leap years that would stand outside the weekly reckoning, which would thus recur exactly every year. This would be a great help in the arrangement of meetings and similar events, their relative positions being invariable, while at present they are subject to shifts of a week. These changes would cause some temporary inconvenience, especially to almanac-makers, but would in the long run be a great simplification. A. C. D. CROMMELIN.

Annual Reports on the Progress of Chemistry for 1917. Issued by the Chemical Society. Vol. xiv. Pp. ix+264. (London: Gurney and Jackson, 1918.) Price 4*s*. 6*d*. net.

THE Chemical Society commenced the practice of issuing a collection of reports on the different branches of chemistry fourteen years ago, with the probable object of supplying to the individual chemist a review of that division of chemistry in which he was particularly interested. At the same time, the book is to furnish the reader with a concise survey of branches in which he has only a general interest. These two objects seem to have been attained with a fair degree of success both in the previous volumes and in the present one. It must be admitted, however, that the chemist who endeavoured to read the book through from cover to cover would run considerable risk of suffering from a severe attack of mental indigestion. This characteristic is, of course, an inevitable result of the compression of a year's material into a comparatively brief report, and does not depreciate the efforts of the various contributors.

As outstanding features in the various reports, the following may be mentioned. Considerable space is devoted to the Bragg method of investigating crystals by means of X-rays, both by Dr. Dawson (general and physical chemistry) and by Mr. T. V. Barker (crystallography and mineralogy). An interesting discussion on phosphorescence is included in Prof. E. C. C. Baly's report (inorganic chemistry). Prof. J. C. Irvine contributes a very readable account of the year's researches on the aliphatic organic compounds, whilst homocyclic compounds are dealt with by Dr. F. L. Pyman, and heterocyclic compounds by Dr. A. W. Stewart. More than half of Prof. F. G. Hopkins's report (physiological chemistry) is devoted to the important subjects of "The Alkaline Reserve of the Body" and "Some Aspects of Nutrition." Dr. E. J. Russell writes on the year's agricultural chemistry in his customary lucid manner and emphasises the value of the present co-operation between farm and laboratory.

E. 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.*]

A Proof that any Transfinite Aggregate can be Well-ordered.

THE following sketch of a proof which seems to me to be not wholly unimportant is given here for certain reasons of priority. I hope that this short account is not unintelligible.

Hartogs's (*Math. Ann.*, lxxvi., 1915, 438–43) considerations may be generalised without difficulty to an investigation of the consequences of the existence of a least ordinal number which is greater than the ordinal types of all possible well-ordered series that can be constructed out of a given aggregate M. This consideration throws no light on whether or not any one of these series actually exhausts M, unless we assume that of two different cardinal numbers one is greater than the other. Instead of using Hartogs's method, I consider all those parts of M which can be well-ordered, well-order them in all possible ways, so that they form what may be called for shortness "chains of M" (so that the same part in different orders gives different "chains"), and imagine as put on one side all chains which are "segments," in Cantor's sense, of other chains of M.

At this point we must introduce a definition: Given a chain (K) of M, let us say that a class K′ of chains of M is a "class of direct continuations of K" if each member of K′ has K as a segment, and also, if L is any member of K′ of type λ, those members of K′ which are of type less than λ are segments of L. Such a class K′ evidently defines one chain and not a class of independent chains, such as Hartogs considers.

Now, in the above process of imagining, we do in fact have a remainder of chains which are not segments of others; for, if not, all chains of M would be segments of other chains of M, and then we could show indirectly that for any such chain K, any ordinal number γ, however great, and any class K′ of direct continuations of K, there is a segment of K′ of type γ. In fact, if there were not such a segment, there would be at least one definite example of each of γ, K, and K′, such that no segment of K′ is of type γ; and thence we can easily show that not every chain of M is a segment of others. But we can prove (*Phil. Mag.* (6), vii., 1904, 61–75) that there is no series which has segments of any ordinal number γ, however great. Thus there is at least one chain of M which is not a segment of some other. It is easy to prove that this chain exhausts M, and that there is a least type of those of chains that exhaust M. Thence, from the fact that the cardinal number of M is an Aleph, we can deduce Hartogs's theorem, determine the form of the limit that Hartogs was really trying to find, and prove Zermelo's (*Math. Ann.*, lix., 1904, 514–16; lxv., 1908, 107–28, 261–81) "principle of selection."

PHILIP E. B. JOURDAIN.

The Bourne, Basingbourne Road, Fleet, Hants, March 12.

Future Supplies of Laboratory Apparatus and Materials.

I HAVE been looking at my list of apparatus and materials which the chemical dealer tells me must wait until the war is over before they can be obtained from Germany. I regret to say the list is a formidable one; I had to add to it this week. Few in our generation will ever knowingly purchase goods made in Germany if they can be obtained from other countries. We feel that German goods must appear to be smeared with the blood of our relatives and countrymen. I take it that my position is much the same as obtains with the heads of other laboratories in the country. Surely, therefore, it is time our British manufacturers realised that it is not much use tinkering with laboratory glass and porcelain ware, if the thousand-and-one other forms of laboratory apparatus have to be purchased in Germany after the war. It seems reasonable to suppose that the orders for laboratory glass and porcelain ware are bound ultimately to accompany the orders for the other requisites.

X. Y. Z.

Long-range Guns.

BY a slip of the pen, double velocity was said, in my article in last week's NATURE (p. 65), to give double range, instead of fourfold.

At that rate, an increase of the velocity of our gun in 1887 would be required from 2400 to 6000 ft. per sec. to make the range grow from 12 miles to 75.

The rule is, of course, not exact except when air resistance is not taken into account. The 12-mile range would have been nearly trebled if it was not for the resistance of the air.

G. GREENHILL.

1 Staple Inn, W.C.1, March 30.

LONG-RANGE GUNS.

THE appearance of a gun with a range of something like seventy or eighty miles has naturally aroused considerable interest, and the question is often asked as to how such long ranges are attained. The answer is that if the shot is to travel far it must get outside the atmosphere, or rather to a height where the density of the air is very small, and that it must be started with such a velocity that in spite of the air resistance in the first part of its course, its remaining speed, after having reached the upper air, shall be sufficient for its further progress.

At the surface of the earth and with ordinary projectile velocities (2000 to 3000 ft. per sec.) the resistance of the air is large compared with the weight of the shot, even for a 12-in. projectile, though, of course, this ratio decreases in the proportion of the area to the volume.

In the absence of air resistance, elementary dynamics show that if a projectile (or particle) is started upwards with an inclination of 45° the ranges would be as follows:—

Initial velocity	Range
1000 ft./sec.	11·6 miles
2000 „	47 „
3000 „	106 „
4000 „	188 „
5000 „	296 „

It is evident, therefore, that, if a gun is to carry seventy or eighty miles, the shot must attain a height where the air resistance is very small, with a remaining velocity of between 2000 and 3000 ft. per sec.

If the temperature of the air at all heights were constant, the air itself would extend to an infinite height, the pressure and density being connected to well-known laws. If, on the other hand, the temperature decreases adiabatically with the height (as is found to be the case, at any rate, up to 40,000 ft. or thereabouts), there is a finite limit of about seventeen miles above which no oxygen or nitrogen could exist. Above this height a projectile would experience no resistance, but even a few miles lower the resistance would be small compared with its weight.

By using graphic methods there is no difficulty in deducing the retardation which the shot undergoes in the earlier part of its flight, though these methods cannot be shown in full in this short article.

I have not computed the requisite initial velocity for a 9-in. shot (such as is said to have been used in the German gun), but it must be of the order of 5000 ft, per sec.

Data for air resistance up to this speed will be found in a paper read by me before the Royal Society on May 28, 1908.

To attain this speed a long bore would probably be more suitable than an extra-strong explosive; at least, this is what I found to be the case in my own experiments.

In the statement given above as to ranges *in vacuo* it has been assumed that the trajectory was parabolic. In reality, of course, it is part of a very long ellipse, the projectile, in fact, behaving as a satellite with an eccentric orbit of which the elements can be readily calculated.

A. MALLOCK.

CLOUD FORMATIONS AS OBSERVED FROM AEROPLANES.

THE recent development of aviation has provided a means of observing clouds which is much superior to any hitherto known. A modern aeroplane can reach the clouds in a very short time, and in many cases get above them. Observations of temperature can easily be obtained, and probably humidity observations would present no great difficulties. The "bumps" experienced also give some information as to the nature of the disturbance causing the formation of the clouds.

It is well known that the two most important processes which cause clouds to form are (1) the mixture of layers of air of high humidity and different potential temperature,[1] (2) adiabatic expansion due to upward movement.

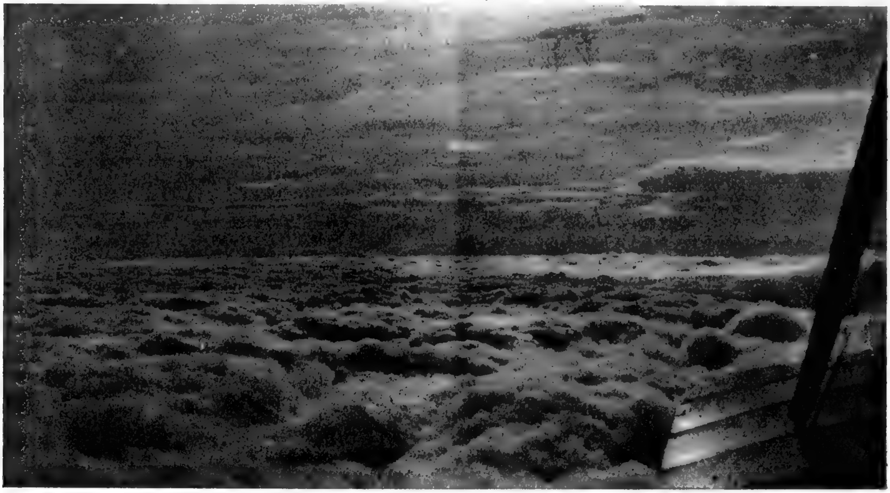
The first process is the cause of most horizontal cloud-sheets, and the latter of the most typical cumulus clouds and also of rain-clouds. Many clouds of cumulus and strato-cumulus character are due to both processes combined.

It has not hitherto been clearly understood precisely how cloud-sheets a few thousand feet above the surface are formed. Observations from aeroplanes show that under these cloud-sheets there is always some vertical disturbance and a lapse-rate of temperature (*i.e.* a rate of decrease of temperature with height) which is little below the adiabatic rate for dry air, while above the clouds the air is undisturbed, and there is a marked rise of temperature for a few hundred or a thousand feet above the clouds. The disturbance within and below the clouds is not violent in the case of a horizontal cloud-sheet, and is of the same nature as the eddy motion discussed by Major Taylor[2] with reference to the fogs off the Newfoundland Banks. The disturbance is transmitted upwards from the earth's surface, and consists of a fairly regular distribution of eddies, which do not last long, the disturbed air soon mixing with the surrounding air. The effect of heating or cooling the air at the surface has been discussed by Major Taylor, but the type of cloud-sheet we are now considering is caused rather by the movement of a body of air over a wide stretch of sea where there is not much change of temperature. In the course of time the air up to the height of a few thousand feet is thoroughly mixed, with the result that the lapse-rate of temperature becomes adiabatic and the relative humidity increases with height; in many cases a cloud-sheet forms at the top of the disturbed layer of a thickness usually less than 1500 ft., often less than 500 ft. As the normal lapse-rate for the atmosphere generally is less than the adiabatic, there is an increase of temperature on passing from the disturbed to the undisturbed layer, which renders slow the further upward penetration of the eddy motion.

[1] Potential temperature is the temperature which a specimen of air would acquire if it were brought down, under adiabatic conditions, from the position it occupied to the earth's surface.

[2] See (1) "Report on the Work carried out by the S.S. *Scotia*, 1913," pp. 48–68 (London, 1914), and, also by Major Taylor, (2) "Eddy Motion in the Atmosphere" (*Phil. Trans*, A Series, vol. ccxv. (1915), pp. 1–26) and (3) "The Formation of Fog and Mist" (*Quarterly Journal Roy. Met. Soc.* vol. xliii., No. 183, July, 1917).

Any meteorological condition which causes a body of air to cover a wide stretch of sea without any irregular disturbance favours the development of cloud-sheets of this type. Fig. 1[3] shows an example of a cloud-sheet which occurred at Brooklands on September 26, 1917, with a well-marked south-westerly current. The clouds extended from 3000 ft. to 4000 ft., and there was a temperature recovery of 6° F. in 200 ft. above them; there was some irregular disturbance near the ground, but not sufficient to disturb the cloud-sheet, where the eddies were evenly distributed. This type of cloud-sheet is most common in quiet winter weather, and the eddies are then not so well marked as in Fig. 1, but are, nevertheless, easily seen, and cause the clouds to be called "strato-cumulus." In anticyclones the air is very warm above the clouds, and in winter the temperature recovery may amount to 15° F. in 1000 ft., as on December 22, 1917, and January 5, 1918, in northern France. Cloud-sheets at these two dates were almost certainly formed originally over the sea; the first was at about 5000 ft., moving from N.N.E., the second at about 4000 ft., moving from W.S.W. For fully 2000 ft. below the cloud-sheets there was much turbulence and an adiabatic lapse-rate, while within 1500 ft. of the ground there was no turbulence noticeable to aeroplanes, and the lapse-rate was zero. Such advances of turbulent cloud-sheets from the sea over the top of comparatively tranquil air near the ground are common in winter in Britain and northern France. Their effect in preventing nocturnal radiation is of great importance.



C. K. M. D.

Fig. 1.—Strato-cumulus at 4000 ft. Rise of temperature 6° F. in 200 ft. above clouds. High clouds of approaching "rain-line" above. Taken, from 6000 ft., Brooklands, 4.30 p.m., September 26, 1917.

The clouds of the cumulus class are caused by turbulence on a much larger scale than that which occurs in the horizontal cloud-sheets. They are formed with strong winds or when the air is being heated at the surface, and are commonest over land and on summer days. The winds crossing the irregular surface of the land, or local differences of temperature, give rise to small variations of pressure, which cause irregular vertical currents and corresponding variations in the horizontal wind velocity. The vertical currents do not usually last long, and soon mix with the surrounding air, but the turbulence extends upwards, and thoroughly mixes the air up to the height of a few thousand feet. The turbulence in these conditions is more violent and less regular than that which causes horizontal cloud-sheets. The clouds are due partly to mechanical mixing of layers of different temperature, partly to the adiabatic expansion of ascending air. The form may be cumulus, fracto-cumulus, or strato-cumulus, and the amount depends mainly on the humidity of the layers mixed up. When the turbulence is due mainly to the wind passing over obstacles on the ground, the temperature of the top of the turbulent region is reduced, and a temperature inversion is often formed above the clouds. The irregular disturbances cause the upper surface of the clouds to be uneven, as in Fig. 2, where the variations of the level of the tops of the clouds amounted to 1000 ft. The highest portions of these clouds reached 8000 ft., and the temperature recovery above these portions amounted to 6° F. There was already a thin, broken, horizontal cloud-sheet

[3] [We are indebted to the Scottish Meteorological Society for permission to reproduce the three photographs illustrating Capt. Douglas's paper. They are selected from a beautiful series of thirteen, all taken by Capt. Douglas, which accompany a paper by him on "The Lapse-line and its Relation to Cloud Formation" in the last issue of the Society's Journa Third Series, vol. xvii., No. 34).—Ed. Nature.]

at 7000 ft., with a slight rise of temperature above it, before it was disturbed by the cumuli rising from below.

On days when the disturbance is due mainly to heating at the surface, and no cloud-sheet or damp layer exists at the height of a few thousand feet, the clouds usually retain the form of cumuli, which are, as a rule, contained within a definite layer the level of which rises during the day. When the clouds have risen to 2000 ft. or more above the surface, the lapse-rate near the ground is adiabatic, but this is not usually the case at the cloud level, with the result that the clouds at the top of the ascending currents are usually colder than the surrounding air, being forced up by small irregularities of pressure. Once the lapse-rate near the ground is adiabatic, large bodies of air may be forced up in this way, forming banks of cumulus clouds. If these enter a layer the lapse-rate of which is above the adiabatic for saturated air, these large cumuli may become warmer than the surrounding air and continue to ascend, and perhaps finally cause showers or thunderstorms. The tops of thunderstorms are seldom below 15,000 ft., and the top of heavy showers usually above 10,000 ft., though if the lower air is very damp, showers may fall from a much lower level. Fig. 3 shows tops of cumuli at about 9500 ft. joined to a shower on the right, and also patches of stratus.

C. K. M. D.

FIG. 2.—Strato-cumulus clouds. Tops 7000 ft. to 8000 ft. Rise of temperature 6° F. in 100 ft. above highest parts. Taken, from about 8000 ft., Brooklands, 11 a.m., August 16, 1917.

We have hitherto only been considering clouds which are due to disturbances originating at the surface. The majority of the upper clouds are entirely independent of superficial disturbances. The same is true of many types of rain-cloud, which are due to upward movement on a large scale; even thunderstorms sometimes develop with their bases at the height of fully 8000 ft., and are independent of disturbances originating at the surface. In many cases rainfall develops over a wide area from high cloud-sheets, which gradually extend downwards as the upward movement becomes more pronounced. The rain area may advance over a wide tract of country, preceded by a high cloud-sheet. The rain-clouds consist of thin mist extending to a great height, and in winter, and at any season above 10,000 ft., they may consist only of thin snow. In France the snow-storm of January 9, 1918, developed from a cloud-sheet of this type, which originally came over high up, and later at lower heights, the snow being finally continuous from the ground to a great height. Rain-clouds of this type may be uniform over wide areas, and there may also be turbulent cloud-sheets near the surface, sometimes joined to the rain-clouds. Sometimes also the lower clouds gather into large cloud-heaps, which cause heavy showers in the middle of the other rain-clouds. The high rain-clouds may themselves be broken into showers by local vertical movements, so

C. K. M. D.

FIG. 3.—Cumuli, with stratus patches and thin stratus above. Tops of cumuli, 9500 ft.; stratus patches, 8000 ft.; thin stratus above, 10,000 ft. Clouds joined to shower on right. Taken, from about 8500 ft., Brooklands, 2 p.m., August 20, 1917.

that rainfall production is usually a complicated process.

The writer has not had enough high flying to be able to make many observations of the upper clouds, but they certainly present an interesting field of investigation well within the possibilities of aeroplanes. C. K. M. DOUGLAS.

PHOTOGRAPHIC DETERMINATIONS OF STELLAR PARALLAX.[1]

THE determination of stellar parallaxes by photography has shown a striking improvement in recent years, and the results obtained with the Yerkes refractor are of the highest order of excellence. Two of the precautions observed in this and similar series of measures are the taking of all the plates at small hour-angles, so as to minimise the effect of unequal atmospheric dispersion in the stars, and the reduction of the magnitude of the parallax star to equality with the comparison stars. This latter precaution is necessary, since any inequality in the driving will have a different effect on the images of objects that differ much in brightness. The usual way of effecting this is by rotating a screen in the form of a sector of a circle in front of the brighter image. By altering the angle of the sector, any desired diminution of light may be obtained.

This method was used for most of the parallaxes in the volume under notice, which, however, mentions an alternative plan, due to Prof. Kapteyn, that has been successfully tried at Yerkes. It consists in taking an out-of-focus photograph of the required region, which on development exhibits the stars as discs of equal size but unequal density. This negative is then used as a screen for the parallax plate. Since the density of each disc is proportional to the photographic brightness of the star that formed it, it is clear that the use of the screen will give nearly equal magnitudes for the stars on the parallax plate.

The parallax work at Yerkes Observatory was begun in 1903 by Dr. Schlesinger, who was appointed director of Allegheny Observatory in 1905; it was continued by Messrs. Slocum, Mitchell, Lee, Joy, and van Biesbroeck (of the Uccle Observatory, Belgium). Up to the end of 1915 131 parallaxes had been determined. The present volume contains the details of the last eighty-five, and a summary of the earlier results, which have already been published. The parallax stars are mainly bright ones, but nearly one-third of them are faint stars with large proper motions.

The parallax of Algol is given as 0·02″; that of 61 Cygni, 0·27″; of 70 Ophiuchi, 0·21″; of ϵ Lyræ (the double-double), 0·00″ (all four components being measured); O.A. (N.) 17,415–6, 0·22″. There are six of the eighty-five parallaxes between 0·1″ and 0·2″, three above 0·2″, and seventy-six less than 0·1″. Four of the stars in the trapezium of the Orion nebula were measured, as there is little doubt that they are actually involved in the nebula. The results are negative for all four (−0·014″, −0·026″, −0·021″, −0·023″), presumably indicating that the trapezium and nebula are more remote than the comparison stars. The possibility is recognised that the latter may themselves be involved in the nebulosity, and a further investigation is suggested, using larger plates that would include stars more distant from the trapezium.

The probable errors of these parallaxes are all in the neighbourhood of 0·01″. The error that is reasonably possible is, of course, two or three times as great. A good illustration of this fact is afforded by the parallaxes found for the pair of stars O.A. (S.) 14,318–20, R.A. 15h. 5m., S. decl. 16°. They are 5′ apart, magnitudes 9·6 and 9·2, spectral types G_5 and G_4, P.M.s 3·693″ in 195·7° and 3·675″ in 195·6°, radial velocities +307 km. and +295 km. These striking facts leave no reasonable doubt that the two stars are physically connected, and have sensibly equal parallaxes. The present volume gives for the parallaxes +0·025″ ± 0·008″ and +0·061″ ± 0·012″ respectively. As Prof. H. N. Russell had previously obtained the values +0·014″ ± 0·023″, +0·045″ ± 0·022″, some astronomers have adopted the view that one star is really some three times as distant as the other. But the close agreement of their abnormally large proper motions renders such a conclusion wildly improbable. In fact, the weighted mean parallax is 0·040″ from the Yerkes plates, and 0·030″ from those of Prof. Russell, a quite satisfactory accordance.

An appendix to the volume gives a detailed description of the measuring machine in use for these photographs. It was made by William Gaertner and Co., Chicago. The screw is 18 mm. in diameter, with 249 threads 1 mm. apart. The nut is 50 mm. long, and the graduated head 18 cm. in diameter, having 1000 graduations. The errors of the screw are extremely small.

A. C. D. CROMMELIN.

[1] "Stellar Parallaxes derived from Photographs made with the 40-in. Refractor." Publications of the Yerkes Observatory, vol. iv., part i.

THE SIKKIM HIMALAYA.

NO section of the Himalaya is more fully known than Sikkim; Kashmir even has not been more assiduously investigated. The information regarding Sikkim is important for two reasons. This country, which extends, between long. 88° and 89° E., from the Bengal plain to the tableland of Tibet, is the only fully explored portion of the eastern Himalaya. Our knowledge of the more extensive territories of Nepal to the west, and of Bhutan to the east, is relatively scanty.

The pioneer explorer of this interesting land was Sir Joseph Hooker seventy years ago. Since 1848–49 many others have studied its fauna and flora, its geology and topography, its scenery and people. Explorers, surveyors, collectors, members of political missions, and expert mountaineers have found in Hooker's "Himalayan Journals," published in 1852, a pleasant companion and a trustworthy guide. Hooker's maps have helped in settling boundary disputes and in conducting military operations.

Artists or climbers who have followed Hooker's path have rarely described their tours; there was little to tell that Hooker had not already told. Scientific travellers have deviated as much as possible from Hooker's track; their writings record facts already noted by Hooker; they less often allude to places he visited.

Among wanderers in Sikkim who have felt the spell of the region and the charm of Hooker's style is Lt.-Col. W. J. Buchanan, C.I.E., who has, in "Bengal Past and Present" (Calcutta Historical Society, vol. xiv.), taken us "In the Footsteps of Hooker through Sikkim and Nepal." The intrinsic value of this interesting article is enhanced by the testimony it bears to the accuracy of Hooker's observations and the soundness of Hooker's conclusions. It forms a fitting and graceful centenary memorial of the great traveller and naturalist.

Besides minor excursions, Hooker made two great Sikkim journeys. During the first—October, 1848, to January, 1849—he explored the upper catchment area of the Rangiet, in western Sikkim, and penetrated some way into eastern Nepal. The second journey—May to December, 1849—took him to the valleys of north-eastern Sikkim, drained by the Lachen and the Lachung, which unite to form the Tista. Wide as Hooker's interests were, he was primarily a botanist, and singularly few of the floral features of the land escaped his eye, especially during the second journey, one episode of which was his capture and imprisonment, along with the Political Officer, Dr. Campbell, by the Rajah of Sikkim.

Much, however, was still left to do. Hooker's friend and fellow-student, T. Thomson, who joined him at Darjeeling, and explored the Khasia Hills along with him in 1850, ultimately succeeded H. Falconer as superintendent of the Royal Botanic Garden, Calcutta, and continued the botanical investigation of Sikkim. T. Anderson, superintendent from 1858 to 1870, did the same.

Hooker, in his "Journals," describes the efforts made to prevent his reaching the Tibetan border. To the energy and tact of Sir G. King, superintendent of the Calcutta Garden from 1871 to 1898, we owe more than the systematic investigation of valleys and passes not visited by Hooker. Though political difficulties prevented King from supplementing Hooker's Nepalese results, he was able to explore the district of Chumbi, which, though politically Tibetan, is geographically Himalayan, as thoroughly as he did Sikkim. Among those whose share in the botanical survey of Sikkim during this period deserves especial mention were W. T. Blanford, C. B. Clarke, H. A. Cummins, D. D. Cunningham, Sir J. Ware Edgar, J. S. Gamble, G. A. Gammie, H. C. Levinge, J. L. Lister, R. Pantling, and Sir G. Watt.

One district, Lonakh, in northern Sikkim, behind the Kinchinjanga *massif*, still remained unexplored. Objection was not taken in 1849 to Hooker's attempt to enter this district, but his party was unable to cut a path through the dense rhododendron forest of the upper Zemu, which blocked the way. Political difficulties frustrated King's wish to explore Lonakh, the "great black south" of the Tibetan graziers, who drive their yaks to its poor alpine summer pastures. An expedition organised by him for the purpose in 1892, under Mr. G. A. Gammie, had at the last moment to be diverted to another district.

This region, difficult of access from the south, was at last traversed by Mr. Freshfield, whose account of his journey, "Around Kanchenjunga," published in 1903, now almost takes the place of Hooker's "Journals." The first Lonakh plants to reach the Calcutta herbarium were sent from the Naku-la by Sir F. Younghusband in 1903. It has been the good fortune of the present superintendent of the Calcutta Garden, Lt.-Col. A. T. Gage, to organise an expedition, led by Messrs. W. W. Smith and G. H. Cave, which in 1909, by investigating this district, has done much towards completing the botanical survey of Sikkim begun by Hooker.

NOTES.

THAT "prevention is better than cure" needs no argument, and yet it may be observed from time to time in the daily papers that the general idea of a Ministry of Public Health seems to be that the various organisations for *treatment* of disease are very specifically involved, and that, provided the interests of these organisations are secured, all might go well. It is only Lord Rhondda who appears to place *prevention* well to the front. Insurance against sickness is necessary where prevention fails, but surely every bed occupied by a sick man or woman is a possible censure upon the prevention side. There are, therefore, two distinct branches of work. Prevention involves the organisation of science, not merely laboratory science, but also the practical applications of the lessons learned in the laboratory, these applications being carried out by scientifically trained men. Treatment involves the reconstruction of our hospital system. If we are to have a Health Ministry and a really national Health Service it is the prevention side that demands, and must receive, the chief attention of our statesmen. For the cure of disease we may justly be proud of our doctors of all ranks. But what is their work? Nine-tenths of it is trying to remedy and cure easily preventable disease. King Edward asked: "If preventable, why not prevented?" and his question has not yet been answered. If the Health Ministry is to be a success its chief aim must be prevention. We who believe in the urgent necessity for a Ministry of Health want to answer King Edward's question, and so to deal with the health of the nation that the next generation will know nothing of preventable disease, or, if it occurs, will regard it as a disgrace, and that the sufferer from any disease the cause of which is known and preventable will be as ashamed to admit it as is now the case with those affections which are known to be the result of excesses and loose living.

FOR several years before the war various branches of science had gradually been acquiring the elements of an international organisation, and in several instances Germany had secured that the central bureaux should be associated with her own national institutions dealing with the branches of science concerned. These arrangements have lapsed since the outbreak of war, either informally, or, as in the case of the International Geodetic Association, by the non-renewal of the diplomatic convention which had constituted and maintained the association. The convention was originally concluded in 1895, and renewed in 1907 for a further period of ten years, so that it ceased to exist last year. In the course of 1916, however, steps were taken by a group of neutral States—Switzerland, Holland, Denmark, Sweden, Norway, Spain, and the United States of America—to constitute amongst themselves, and under terms resembling those of the old convention, a small association which might maintain the work of the wider body, if only in a restricted form; this neutral group is to dissolve two years after the conclusion of peace. Among other services, it has assured the continuance of the international scheme for determining the variation of latitude. The question of the future of international geodetic work has recently been raised, perhaps a little prematurely, by M. Ch. Lallemand, Directeur du Service du Nivellement de la France. In a letter addressed to the delegates from all the countries of the Entente to the lapsed association, and also published in the *Revue générale des Sciences* (February 28, *Supp.*, p. 17), M. Lallemand advocates the foundation of a new body, to be confined, at least initially, to the Entente countries. With this in view he has sent out a draft of a proposed convention, which, amongst its provisions, departs from former practice in giving voting power to the different countries, not equally, but in some kind of proportion to their relative importance. A special conference will be called to discuss the proposals as soon as occasion offers.

From time to time the safety of the numerous prehistoric remains on Salisbury Plain has been a matter of anxious concern to antiquaries in consequence of the use of the Plain by the military authorities. There has been every evidence of goodwill on the part of the military authorities, but their best intentions and endeavours have not been sufficient to prevent a considerable amount of mischief being done. A valuable step in advance has recently been taken at the instance of the Society of Antiquaries by the appointment of Lt.-Col. William Hawley, of Salisbury, the able explorer of Old Sarum, as an inspector to watch over the safety of these remains and report to the War Office any injury with which they may be threatened. It is to be hoped that his authority may be extended in the direction of empowering him to take effectual steps to prevent any such injury. The safety of Stonehenge itself is not so well assured as could be wished. Since it was acquired by a public-spirited citizen of Salisbury it has been placed in the charge of a custodian employed by him, and watched over by a police constable, and for their accommodation two cottages had been provided in the immediate neighbourhood of the monument. For some military reason which has not been disclosed, the authorities have taken over these cottages and ordered them to be demolished. As there are no other cottages in the neighbourhood, the necessary consequence seems to be that the custodian and constable cannot exercise constant supervision as hitherto. The Society of Antiquaries has adopted the following resolution, drawn up by its president, Sir Arthur Evans:—"The Society of Antiquaries has heard with concern that the War Office proposes to demolish the two cottages by Stonehenge, which serve as the domiciles of the custodian and the police constable charged with the safe-keeping of the monument. As these are the only available cottages in the neighbourhood the society feels that such action may be fraught with perilous consequences, and therefore begs leave to direct the attention of the Secretary of State for War to the urgent necessity of taking adequate steps to protect this national monument from injury or defacement."

The *Times* of March 28 publishes a long Reuter message from Stockholm containing parts of the memorandum on the crisis which led to war drawn up in August, 1916, by the former German Ambassador in London, Prince Lichnowsky. The memorandum decisively fastens upon Germany the responsibility for the war, and is a document of high historical importance, especially if the whole of it represents the British attitude so truthfully as is done by Prince Lichnowsky in the following reference to what is thought of science and learning:—"In no place . . . is an envoy's social circle of greater consequence than in England. A hospitable house with friendly guests is worth more than the profoundest scientific knowledge, and a learned man of insignificant appearance and too small means would, in spite of all his learning, acquire no influence. The Briton hates a bore and a pedant. He loves a good fellow."

Mr. H. J. Helm, whose death occurred last week at Bromley, Kent, was for several years deputy-principal chemist of the Government Laboratory, which position he held on his retirement from the public service in 1904. For a considerable period previously Mr. Helm had been a superintending analyst in charge of chemical matters connected with the assessment of revenue, and his technical knowledge of the brewing, distilling, and tobacco-making industries, as also of the legal enactments by which the operations of these industries are controlled, enabled him to render valuable assistance in matters of fiscal chemistry to Sir Edward Thorpe when the latter succeeded the late Dr. Jas. Bell as head of the laboratory. Cautious and shrewd, Mr. Helm had a marked sense of what was reasonably workable in applying laboratory results to industrial practice, and his advice tended always to assist in holding the balance fairly between the interests of the Exchequer on one side and those of the manufacturing and general public on the other. He was of somewhat reserved, but withal kindly, disposition, and the news of his decease, albeit at the ripe age of seventy-nine, will be heard with regret by many friends and official acquaintances.

The special correspondent of the *Times* at the War Correspondents' Headquarters in France says that information as to the long-range guns which are shelling Paris was obtained last December from prisoners. The guns were said to be of 15 in., and fined down to about $8\frac{1}{4}$ in. They were, according to one informant, 79 ft. long, and in the trials had carried 75 kilometres, and were expected to carry 100 kilometres, or 62 miles. More remarkable than the gun was the shell, which was 59 in. in length and prolonged into a bottle neck at the front, with two copper driving bands and rifling extending in advance of these, the weight of the shell being about 350 lb. The two copper driving bands are 1 in. wide, and in front of these is a steel or iron band of 3 in. or more, over which the rifling extends, which would give the shell great stability in the air. According to the latest information derived from prisoners, the *Times* correspondent says, the gun's length would probably be about 104 calibres—that is, 104 times the diameter of the bore—which is getting on for twice the length of any gun of the same calibre we make. The muzzle velocity is estimated to be from 4500 to 5000 ft. per second, and it is conjectured that the gun is elevated to an angle perhaps as high as 55°, so that the main part of the path of the shell would be in a region where little air resistance would be experienced.

WE regret to see the announcement of the death of Mr. G. M. Seabroke, director of the Temple Observatory, Rugby.

THE annual oration of the Medical Society of London will be delivered by Dr. T. S. Hyslop on May 13, upon the subject of "Degeneration in Art, Science, and Medicine."

WE learn from the *Times* that at the annual meeting of the Association of Chambers of Commerce to be held in London on Tuesday and Wednesday next a Bill for providing a decimal system of coinage will be submitted for approval. The terms of the Bill have been agreed on by the Executive Council of the association, the Bankers' Institute, and the Decimal Association. Arrangements are being made for its immediate introduction in the House of Lords.

IN the *Museum Journal* (vol. viii., No. 2, June, 1917) there is a remarkable account of human sacrifice among the Mundurucu Indians on the Tapajos River, a tributary of the Amazon. Disease is believed to be caused by a Bokaidpot, or evil genius, in the village. This person is identified by the medicine man, and he is slain if many deaths or much sickness occur. The victim is strangled by means of a cord pulled tightly round his neck, and next morning, after the chief has seen it, the body is cremated. The accused knows he is to be killed and offers little resistance. Two men are appointed to do the deed at the first opportunity; they may select their time, but cannot escape the duty.

MR. T. SHEPPARD, in the *Naturalist* for February, describes a collection of implements of the Bronze age in the Whitby Museum. There are in all twelve specimens, of which two are evidently of Irish origin, and some are imperfect. One rare type of implement, a socketed dagger, is unfortunately imperfect, the blade being broken, and a crude attempt having been made to sharpen the broken part for use as a chisel. Two specimens are obviously forgeries, and seem to be rather clumsy attempts to imitate genuine weapons. These are clearly the work of "Flint Jack," who was a native of the Whitby district, and spent some time there in his later years doing his best to satisfy the demands of collectors.

THE Hon. J. W. P. Murray, Lieutenant-Governor of Papua, has forwarded to Mr. S. H. Ray a vocabulary of the people between the Fly and Strickland Rivers, Papua, which is published in the March issue of *Man*. These people live about Lake Murray, a large, swampy tract which lies in the angle formed by the junction of the Fly and Strickland Rivers, discovered by Messrs. Massy-Baker and Burrows in 1913. The language of these people seems to be closely connected with that of the Merauke or Tugeri tribe, and the tribes connecting the races of these two areas must be sought in the still little-known interior of the island rather than along the coast. In one village stuffed heads, like those found on the Strickland, and described by D'Albertis, were noticed. But the latter was mistaken in believing that the skull was removed through a long cut on the neck; as a matter of fact, the flesh is replaced by clay or fibre; the skull is not removed.

THE volume of Scientific Reports of the Agricultural Research Institute, Pusa, for 1916–17 continues the record of valuable services rendered to Indian agriculture by this institution. The report of the director is accompanied by the reports of the heads of the various scientific divisions, and the matters dealt with are so varied as to preclude any effective summary within the compass of a brief note. A few subjects chosen at random include starch production, soil aeration, wheat-breeding, indigo, paddy diseases, disease-carrying insects, and green manuring. Detailed reports on some of these subjects have been published during the year and noted in these columns.

A BACTERIAL disease of wheat in the Punjab is described by Mr. C. M. Hutchinson in the Memoirs of the Department of Agriculture in India (vol. i., No. 7). In the affected wheat the inflorescence and parts of the stem are covered with a bright primrose-yellow slime, and the growth of the plant may be interfered with and the stem distorted. The appearances are well depicted in a coloured plate. The yellow slime is crowded with bacilli, which can be readily cultivated on a variety of culture media, yielding yellow growths on many. Inoculation of wheat plants with cultures successfully reproduced the disease provided that the plants were kept in an abnormally moist atmosphere. The bacterium is named *Pseudomonas tritici*.

PROPHYLACTIC inoculation against pneumococcal infections is the subject of a research by Mr. F. S. Lister (Publications of the South African Institute for Medical Research, No. x.). He shows that from 63 to 77 per cent. of all cases of pneumonia among the Transvaal native miners are caused by one or other of three races or groups of the pneumococcus designated A, B, and C. By prophylactic inoculation, pneumonia has been completely abolished on the Crown Mines. The method is to administer three subcutaneous inoculations of one cubic centimetre each of a vaccine containing representatives of the three groups, A, B, and C, of pneumococci in equal proportion, and containing seven thousand million cocci per c.c. Details are given for the preparation of the vaccine, and statistical data of the results obtained by its use are tabulated.

THE cessation of the trade in tinned articles of food during the war has forced India to rely on its own resources. An exhibition of such local productions held at Calcutta early in January last shows how much progress has already been made. The sun-drying of vegetables has been undertaken; dried and made into bricks, the weekly supply for a thousand men on active service can be carried in twelve kerosene tins, an easy load for two mules. Biscuits are being largely made of the flour of Pusa wheat; macaroni, vermicelli, and ground rice are made. Hams and bacon come from the Balaclava farm at Ghoom, the produce being sold at little more than half the price of the imported article. Cured and tinned fish and a large selection of condiments are another branch which has proved very successful. The exhibition will do much to encourage this new trade in food for Europeans in India.

THE migrations of the king-fish, or opah (*Lampris luna*), and of the sun-fish (*Orthagoriscus mola*) in British waters are briefly summarised in the *Scottish Naturalist* for February by Prof. D'Arcy Thompson. His analysis of recorded captures of the first-named, all of which were secured with a hook, seem to show that the northern movements of this fish lie in a sort of belt along the edge of the deep water from the eastern side of the North Sea round the Shetlands to the outer side of the Hebrides. This migration unmistakably attains its maximum during the summer months, though there are many records of specimens taken during winter. But these are all inshore records, suggesting that such individuals must be regarded as stragglers which have lost their way. The migrations of the sun-fish show a double maximum, one in early summer for our southern and western coasts, and one in autumn for the east and north. It has been suggested that the sun-fish is, so to speak, a passive migrant, carried along by ocean currents with no "proper motion" of its own. Prof. D'Arcy Thompson is by no means inclined to accept this view. Though he agrees that the great Atlantic "Gulf

Stream" current plays an important part in these movements, he is led to the conclusion that food is the influence immediately at work, these fish preying largely on eel larvæ or "leptocephalids," which, during the summer months, are making their shoreward migration from the Atlantic. "There would seem," he remarks, "to be a close and even precise correspondence between this periodic annual migration of the Leptocephali and the appearance of the sun-fish in our home waters."

MR. E. E. GREEN, in the *Entomologist's Monthly Magazine* for March, makes a plea in favour of the introduction into Great Britain of two species of exotic butterflies. Mischief enough already has been wrought in many parts of the world by experiments of this kind, and it is devoutly to be hoped that further ventures in this direction will not be made without the fullest consideration of the possible consequences.

THE structure and relationships of Bathynella, the European "well-shrimp," are discussed by Dr. W. T. Calman in a recent paper in the *Quarterly Journal of Microscopical Science* (vol. lxii., part 4, 1917). From the study of a few fresh specimens from Switzerland Dr. Calman definitely confirms his long-held opinion that this tiny, blind crustacean is a degenerate member of the Syncarida, where it finds its place together with Anaspides and the remarkable allied genera that inhabit certain Tasmanian and Australian lakes, and Palæocaris and other fossils preserved in rocks of the Palæozoic era.

THE advance of our knowledge about the part played by blood-sucking insects in the spread of disease is of such importance and so continuous that the paper by M. E. MacGregor (*Bull. Entom. Res.*, vol. viii., part 2, 1917), giving a summary of the recorded "Insect Vectors of Disease," will be of value for reference by students. Ticks and other Acarina are appropriately included in the tables, as well as true insects. Mr. MacGregor warns the reader that his lists "can in no way claim to be complete," but the omission of the sheep-flies (*Lucilia sericata*, etc.) from "the chief insects and Acarina that are directly the cause of disease in man and his domestic animals" is somewhat surprising.

IN a recently issued pamphlet, "Zur Auffassung der Verwandtschafts-Verhältnisse der Tiere, I," Prof. J. E. V. Boas, of Copenhagen, speculates on the relations of the Echinoderms. He suggests that they were derived, through the Crinoids, from a sessile polyp, and he adduces in support of his view many interesting resemblances of structure. Sedgwick showed how all animals with a body-cavity distinct from the gut might have originated from the Cœlentera, and the article "Echinoderma" in the "Encyclopædia Britannica" (1902, 1911) applies this in more detail to the Echinoderms. But the direct and easy transition imagined by Prof. Boas fails to explain the peculiar torsion of Echinoderm structure, or the traces of bilaterality the existence of which he is bold enough to deny. Had he remedied his admitted want of knowledge of some English writings on this subject he might have dealt with these difficulties more convincingly. Prof Boas then proceeds to construct an ancestral worm (an "Ur-Chætopod," to be precise), from which he would derive the Nemertines and flat-worms, the Enteropneusta, the Chætognatha, and the Brachiopoda; and he connects this ancestor with the Echinoderms by way of the Holothurian Synapta. He brings out, it is true, a number of interesting analogies, but most zoologists would ascribe these to similarity in the mode of life. A brief final chapter deals with the germinal layers and the development of the cœlom. The author insists throughout that his hypotheses are possibilities rather than proved theories. If they present difficulties even as possibilities, we may none the less be grateful to Prof. Boas for presenting ancient problems in a new light and in a manner that is both interesting and easy to follow.

IN the February issue of the *Scientific Monthly*, published in New York, two interesting articles on meteorology in connection with the war appear. Prof. R. DeC. Ward writes about "Weather Controls over the Fighting in the Italian War Zone," and gives details about the rain- and snow-fall and the temperature during the past three years. The fighting has been chiefly in mountainous regions, and the passes have often been blocked by heavy snow. Prof. Alexander McAdie deals with "Meteorology and the National Welfare." A considerable part of his article is concerned with the prevailing winds, such as the trades and monsoons, and Prof. McAdie points out how the character of a season in the United States depends on the direction of the prevailing wind in that particular season. He shows how aviation will depend upon a knowledge of these winds, and expresses the hope that much information about the currents and temperature of the upper air useful for meteorology will be obtained by aviators after the war. In the same number of the magazine there is also an article on "Snow and its Value to the Farmer" by Dr. Andrew H. Palmer, which is interesting and contains many good reproductions of photographs.

SOME experiments carried out at the Cancer Research Department of the Middlesex Hospital are described by Mr. J. C. Mottram and Dr. S. Russ in a paper in the Proceedings of the Royal Society of Medicine, vol. x. The paper gives a detailed record of experimental observations of a case of carcinoma under radium treatment. An ionisation method was employed to determine the intensity of the radiation emitted by the several applicators used, and, in addition, measurements of the absorption of the β and γ radiations by the skin and subcutaneous tissues were made. This was done in order to be able to compare the effect produced upon the skin when it is irradiated in such a manner that equal amounts of β and γ rays are absorbed by it. Details of the observations on the skin and subcutaneous nodules subjected to screened and unscreened β and γ radiations are given. As a result of the tests it is established that, first, if the skin is irradiated in such a manner that the neighbouring portions absorb equal amounts of β- and γ-ray energy, similar reactions are produced, but they are, in general, more pronounced in the case of the γ rays. Secondly, if the skin is exposed to a large amount of β or γ radiation for a short time the reaction is more pronounced than if the same dose is given using a smaller amount of radium for a correspondingly prolonged period. The effect on the malignant subcutaneous nodules was not, however, appreciably different in the two cases.

THE *British Journal of Photography* has reprinted in its issues for March 1, 8, and 15 a paper on "Axial Aberration of Lenses," by Messrs. Tillyer and Shultz, of the Bureau of Standards at Washington, which has appeared in the Journal of the bureau. After a clear account of the way in which zonal aberration and the sine condition affect the image, the authors describe a modification of the Hartmann method which they have introduced for the determination of the axial aberration of lenses and instruments. In the case of a lens monochromatic light of wave-length 4250, 4750, 5500, or 6500 Ångström units is allowed to fall on a metal screen seven metres away, perforated with holes a millimetre in diameter and three millimetres apart.

The lens is placed immediately behind the screen, and the thin pencils of light which pass through the holes are received on a photographic plate placed at suitable points between the lens and its focus, and beyond the focus. From the subsequent measurements of the positions of the spots of light on the plate curves showing the variation of the effective focal length, the spherical aberration and the coma for each of the four kinds of light used are drawn. Seventeen sets of curves for typical lenses are reproduced in the paper.

THE Institution of Electrical Engineers has issued in pamphlet form the standard clauses for street lighting specifications which are the outcome of the deliberations of the Joint Committee consisting of delegates of the Institution of Electrical Engineers, the Institution of Gas Engineers, the Institution of County and Municipal Engineers, and the Illuminating Engineering Society, and appointed in 1910. The specification prescribes the form of tender, particulars of lighting units, and the general nature of the contract. It is proposed to classify streets in five classes, having respectively a minimum illumination of 0·01, 0·025, 0·04, 0·06, and 0·1 foot-candle, the minimum being measured with a suitable photometer in a horizontal plane 3 ft. 3 in. from the ground. A minority report expresses the dissent of the council of the Institution of Gas Engineers to the proposed basis of measurement, and it is preferred that contracts for street lighting should be based on the average candle-power of the light source ascertained at two or three prescribed angles. The points at issue were dealt with in the discussion of a paper on this subject by Mr. A. P. Trotter before the Illuminating Engineering Society in 1913, but complete agreement was not attained. As the matter has been under consideration for six years it was decided to publish the clauses as they now stand, accompanied by a minority report. It is hoped that they will be found useful when methods of street lighting are reviewed after the war. Copies can be obtained from the secretary of the institution, price 3*d.*, post free 4*d.*

THE relation between temperature and the pressure of a saturated vapour is of great theoretical and practical interest, and a very extensive literature already exists on the theoretical side, special attention having been given to the relationship in the case of water and water vapour, and ice and vapour. So far as the vapour pressure of ice is concerned, experimental determinations have been carried out with considerable accuracy in recent years by Scheel and Heuse and others, but there has been a great need for a series of exact determinations of the vapour pressure of ice at low temperatures, in order partly to correct the values obtained by Scheel and Heuse, and partly to see whether the Nernst formula holds good down to the lowest pressures. Such a series of determinations has been carried out with the greatest care by Sophus Weber, working in the laboratory of Prof. Kammerlingh-Onnes at Leyden (Communications from the Physical Laboratory of the University of Leyden, No. 150). The method employed was the ordinary static method in combination with the absolute manometer and the hot-wire manometer of Knudsen. The measurements extend over a range of temperature from about -22° to -190° C., and the values have been compared with the Nernst formula,

$$\log p = \frac{-2611 \cdot 7}{T} + 1 \cdot 75 \log T - 0 \cdot 00210\, T + 6 \cdot 5343.$$

The concordance has been found to be particularly good. By the introduction of a quantum-formula due to Pollitzer, Nernst has made his equation more rational, but so far as agreement with experiment is concerned, there appears to be little to distinguish the two expressions. Incidentally, it may be said, the experiments of Weber show that water vapour at a temperature of -80° has a molecular weight of about 20, whereby partial association is indicated.

THE customary methods for the preparation of plant nucleic acids are rather cumbersome and necessitate a peptic digestion of the nucleoproteins extracted. Messrs. G. Clarke and S. B. Schryver have succeeded in avoiding the peptic digestion, and their method of procedure is described in the *Biochemical Journal* for December. In the preparation of nucleic acid from yeast, the latter, after pressing, is treated with a large excess of 95 per cent. alcohol for twenty-four hours, and then boiled for two hours in the same solvent, whereby the protein-complex is rendered insoluble in sodium chloride solution. The yeast is then filtered, pressed, dried at 37°, ground to a fine powder, and extracted for four to five days with 10 per cent. sodium chloride solution at 60°–80°. When the clear extract is treated with hydrochloric acid a characteristic precipitate of nucleic acid separates and settles to a hard cake at the bottom of the vessel. After standing, this is washed with 50 per cent. alcohol until free from chlorine, left standing overnight in 95 per cent. alcohol, and finally washed with absolute alcohol and ether. The yield varied from 1·4 to 1·6 per cent. of the dry alcohol-extracted yeast. The crude nucleic acid was best purified by dissolution in warm 10 per cent. sodium acetate solution, and reprecipitation with hydrochloric acid. Nucleic acid can be prepared from wheat embryos in a similar manner, but in this case it is found advantageous to remove the starch by hydrolysis with taka-diastase before extracting with sodium chloride solution.

OUR ASTRONOMICAL COLUMN.

INFRA-RED SOLAR SPECTRUM.—By the use of plates stained with dicyanin, Mr. W. F. Meggers, of the Washington Bureau of Standards, has obtained an excellent series of photographs of the solar spectrum in the region from 6800 A to 9600 A (*Astrophysical Journal*, vol. xlvii., p. 1). These photographs thus provide material for accurate determinations of wave-lengths in continuation of the classic tables of Rowland, which did not extend further than the approximate limit of the visible spectrum at 7300 A. Photographs in the same part of the spectrum of more than forty of the chemical elements have also been taken, and nearly 400 of the solar lines have been identified with lines in the spectra of eighteen elements. Two hundred lines are accounted for by iron, sixty-three by nickel, twenty-seven by titanium, twenty-two by cobalt, and smaller numbers by chromium, silicon, manganese, calcium, and other elements. One thousand six hundred lines remain for the present unidentified. In addition to the well-known bands due to terrestrial oxygen, there are others which appear to be due to water vapour. The separation of the solar and telluric lines has been undertaken at the Allegheny Observatory by the solar rotation method. Publication of the wave-lengths is postponed, but reproductions of the solar photographs, with wave-length scales, are included in the paper.

HARVARD COLLEGE OBSERVATORY.—A recent report of the committee appointed to visit and report upon the Harvard College Observatory refers chiefly to the valuable services rendered by the director in promoting co-operation among astronomers. It is now about forty years since Prof. Pickering began to advocate the advantages of united efforts in carrying out some of the larger investigations in astronomy, and at the present time a considerable amount of the work of the

Harvard Observatory is carried on in co-operation with other institutions. Prof. Pickering has also assisted largely in the organisation of amateur astronomers in America, especially for the observation of variable stars, in which thirty observers are now associated. For this work the observatory has furnished suitable charts, and determinations of the magnitudes of nearly 5000 reference stars.

Harvard Circulars Nos. 203 and 204 have also been received. The first includes particulars of asteroids which will attain magnitude 10, or brighter, during 1918, and the second contains a valuable summary of the observed magnitudes of Nova Persei No. 2 from 1902 to the end of last year, together with a list of comparison stars suitable for future determinations.

The Canadian "Observer's Handbook."—A useful service to its members is rendered by the Royal Astronomical Society of Canada in the annual publication of "The Observer's Handbook." It includes a collection of astronomical data, referring especially to the sun, moon, and planets, arranged very conveniently in the form of a calendar. There is also a special list of occultations, calculated for Ottawa. Tables which vary but little from year to year have been omitted from the present issue.

Ephemerides of Algol Variables.—In the *Journal des Observateurs*, vol. ii., No. 4, M. Luizet has given a valuable series of tables, from which observers can readily prepare a list of the dates of occurrence during the present year of minima of 123 variables of the Algol type. The epoch of the first minimum occurring in each month is given in the first table, and the length of period, and multiples thereof, in the second. The variables are designated by the notation of André, as well as by that of Argelander.

THE TRAINING OF THE FRENCH ENGINEER.

In the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* for September-October last appears a valuable report of the proceedings of the Society of Civil Engineers of France concerning the training of engineers of the first rank, alike for the special services of the State and for leading positions in industry. Not only is the specialised training required considered in the article, but also the previous preparatory education. The matter arose on the presentation of an important communication from M. Léon Guillet, a member of the society, which was considered at a special session of the society held on November 3, 1916, at which the Minister of Commerce and Industry presided. The communication embraced a comparative study of the subject of technical training as it is pursued in France and abroad, a thoughtful criticism of the existing means and methods of such instruction and the preparation required for it, and an expression of personal views as to the lines upon which in future both preparatory and technical studies should proceed. A special commission was appointed, which sat during five sessions, extending to the end of April, 1917, and took important evidence from professional and other persons engaged in engineering.

An official invitation was received by the society in January, 1917, from the Minister of Commerce and Industry, to formulate proposals for the essential modifications required, in its opinion, to be introduced to ensure the more efficient education and training of professional engineers. These proposals take the form of recommendations relative to reforms in the aims and methods of secondary education, as a preparation for higher technical schools, in which it is suggested that the classical studies should be lessened, the teaching of modern languages encouraged, and courses in manual exercises introduced. It is also suggested that the plan of instruction should be arranged so as to meet the needs on one hand of those proceeding to higher normal schools, and on the other of those entering the technical high schools.

Great importance is attached to the necessity for the fullest opportunity of laboratory practice in the technical high schools, and for the encouragement not only of a spirit of individual research and inquiry in the students, but also of a more intimate relation between them and the teaching body with less merely *ex cathedra* teaching. It is laid down as essential that the directing and teaching *personnel* of the engineering schools shall be recruited from persons actively associated with industrial conditions, and that the students themselves shall have had the opportunity of work in the factories and of travel-study in the workshops of France and in foreign countries. The vital importance of the economic aspect of industry is insisted upon, and with the view of increasing French influence abroad, every encouragement should be given to foreigners to follow in whole or in part the instruction in the technical high schools, and, finally, it is recommended that so far as possible the native pupils shall be admitted without fee, and assisted, where necessary, by loans without interest. It is suggested that regular military training shall be maintained in these schools, that the time spent in them shall count as two years in the Service, and that the one year of effective service shall consist of six months with the colours and six months in the service of the State or in industries susceptible of contributing to the national defence, or in camp instruction for officers.

Proposals are made for further specialised and advanced instruction of a post-graduate character, and after the manner of the newly founded High School of Electricity, it is suggested that institutions dealing respectively with machinery and iron and steel construction, metallurgy, chemistry, textiles, public works and railways, and naval construction should be established, and short technical courses of a very advanced character dealing with the most recent progress in technical science offered to professional engineers engaged in works. The proposals are further elaborated in a long communication from the vice-president of the society to the Minister of Commerce and Industry which is well worthy of the attention of the engineering profession in this country.

NEMATODE PESTS.

Prof. Warrington Yorke and Dr. B. Blacklock (in Annals of Trop. Med. and Parasitology, vol. xi., No. 2, 1917) have recorded a series of interesting observations on the periodicity of the larvæ of the nematode worm, *Filaria bancrofti* (*nocturna*), in an Australian who contracted the infection in Queensland. It is well known that during the night the larvæ of this species are concentrated in the cutaneous vessels, while during the day they are present there in small numbers only. The authors estimated the number of larvæ in the cutaneous blood every two hours for a period of twenty-four hours on December 21–22, 1916, and again on January 5–6, 1917. The maximum concentration observed was at midnight, when there were 12,850 larvæ per cubic centimetre. Although the number of larvæ fell to a low level during the daytime they were never absent, the minimum number noted being 50 per c.c. of cutaneous blood. A discussion of the observations has led the authors to the conclusion that the nocturnal periodicity of the larvæ is primarily dependent upon periodic variations in the arterial supply of larvæ to the cutaneous vessels. The periods of sleep and activity of the patient were reversed, and there resulted a gradual change in regard to the period of the cutaneous immigration of the larvæ. After four days the maximum concentration of the larvæ in the cutaneous vessels had been changed from midnight to 6 a.m., and after eleven days to midday. Graphs showing the number of larvæ per c.c. of blood passed in the urine reveal the existence of a regular periodicity corresponding with that of the larvæ in the cutaneous blood, with the difference that the time of maximum concentration of larvæ in the renal and vesical vessels was several hours later. Messrs. Malins Smith and Matthews give, in the same number of the Annals, further records of the occurrence of intestinal protozoa in non-dysenteric cases. Their results show that among the 200 returned soldiers examined in Liverpool *Entamoeba histolytica* was present in twelve of the 158 cases, with no previous history of dysentery.

Dr. N. A. Cobb, of the United States Department of Agriculture, has published (in *Nematology*, vol. iii., pp. 431–86) an account of the nematode genus Mononchus. The genus is of world-wide distribution, and some of the species are cosmopolitan. Mononchs are regularly present in arable land of a sandy or loamy nature, and sometimes occur in great numbers; the author estimates that there were at least thirty millions per acre in the top six inches of a field of maize in New Jersey. Most mononchs are carnivorous; they have been found to feed on protozoa, on rotifers, and on other nematodes. One cosmopolitan species was found by the author in Florida feeding on the larvæ of *Heterodera radicicola*, a serious root-pest, and it is suggested that further investigations may reveal the possibility of utilising mononchs to reduce the enormous losses in crops due to plant-infesting nematodes. A description of the characters and anatomy of the genus is given, and it is stated that the females of many, probably of most, species are really hermaphrodite, the gonad producing also spermatozoa, which are so minute that they have apparently hitherto escaped notice. Males, if found at all, are nearly always rare, and of most of the species males are not known. A key is provided to the subgenera and to the fifty-seven species—including twenty-eight described as new in this memoir—and the text has seventy-five excellent figures.

RAINFALL DISTRIBUTION OVER FRANCE.[1]

THIS is the first portion of a contemplated large investigation into the rainfall distribution over France, and deals with the *régime* over the North-West Provinces. Other memoirs will contain a discussion of the data for the south-west, north-east, and south-east of the country for the fifty years 1851–1900. In the work under notice, which is an extract from the memoirs of the French Central Meteorological Office, full particulars are given of the data used in compiling the maps of average rainfall based on a fifty years' normal, by a comparison of short-period data with standard stations, affording records for the complete series. In some cases the standard stations seem to be at a considerable distance from the short-period record to be corrected to the fifty years' normal.

The variability of rainfall based on records for sixteen stations in France and adjacent countries during the second half of last century is discussed, from which it is shown that the departures of individual years from the normal are in accordance with the theory of probabilities. A list of the stations arranged in river basins is given by departments, along with the altitude and the period of observation. Monthly isohyetals are drawn at intervals of 10 mm. up to 100 mm., but at 120 mm. and 150 mm. thereafter, while on the annual maps the intervals extend to 100 mm. A summary of the leading features governing the rainfall distribution is given for each month and for the year.

In almost all the regions considered October is the wettest month, the rainfall exceeding 100 mm. in the country of Caux, the department of the Manche, the western part of Brittany, and the heights of Gâtine, the maximum being 151 mm. at Saussemesnil; while the driest areas in this month are the middle valley of the Seine, the basin of the Eure, and on the Beauce, where the rainfall is between 50 mm. and 60 mm., but not under the former value. The driest month is February, not only as regards the actual quantity, but also taking into consideration the shortness of the month.

For the whole year the driest regions are the basins of the Seine, the Loire, and the Oise, where the precipitation varies between 500 mm. and 600 mm. The stations where more than one metre of rain falls are extremely few, and are mostly located in mountainous areas, the maximum being 1181 mm. in the Monts d'Arrée. No detailed description appears of the methods of mapping the material utilised. Rivers are shown, but towns, railways, and departments are not indicated, nor are the orographical features shown. The maps clearly indicate the very patchy distribution of rainfall, and have evidently been drawn with much care. The originals were on a scale of 1 : 1,500,000, or twenty-two miles to an inch, and then reduced for publication on a scale of thirty-nine miles to an inch.

[1] "Études sur le Climat de la France. Régime des Pluies. Première Partie. Considérations générales: Région du nord-ouest." Par M. Alfred Angot. Pp. 128+13 plates.

MINERAL PRODUCTION OF PERU AND THE PHILIPPINE ISLANDS.

THE official report upon the mineral production of the Philippine Islands for the year 1915 has recently been issued by the Division of Mines, Bureau of Science, of the Government of the Philippine Islands. The importance of the gold production far outweighs that of any other mineral; its value is returned as 2,633,528 pesos, say about 274,000*l*., being an increase of 12·1 per cent. above that of 1914. The gold bullion, of course, also carries a certain amount of silver, which is valued separately. The only other metallic product is iron, of which ninety-six tons appear to have been produced, this being only about one-half of the production of the previous year. This iron is all produced in small native furnaces, and is worked up into ploughshares or similar articles; the main reason in the falling off is the competition of inferior articles, made from scrap-iron. There is no production of native coal, none having been worked since 1912. The other minerals, of which returns are included, are salt, sand and gravel, clay products, stone, lime, and mineral waters. The total value of all these is estimated at rather less than the value of the gold output.

The mineral statistics of Peru for the year 1915 show a considerable increase in most of the products according to the report (No. 83) recently published in Lima. The total value is given as 5,930,000*l*., being an increase of 42 per cent. above that of 1914. This increase is due in part to the important rise in the value of mineral products, but it must be noted that this rise did not extend to the value of silver, and as silver ranks high amongst the mineral productions of Peru, the increase is less marked than it would otherwise have been. The leading products are copper, 34,727 metric tons; petroleum, 363,162 metric tons; silver, 294,425 kilos.; vanadium ore, 3145 metric tons; gold, 1690 kilos; coal, 290,743 metric tons. These are the only minerals the annual value of which exceeds 200,000*l.*; all the others are far less important. The production of copper, already very important, appears to be likely to increase still further. It is also noteworthy that of the total export of copper no less than 93·85 per cent. was in the form of bars, so that practically the whole of the copper ores produced in Peru are now smelted in that country. This effect is largely due to the heavy rise in freights; before the war these were about 30*s.* to 2*l.* per ton, whereas in 1915 they rose to 5*l.* to 6*l.* per ton without taking the increased cost of insurance into account, so that for any ore or matte containing under 40 per cent. of copper the rise in freights would outweigh a rise of 10*l.* in the price of the metal. This effect would be even more marked in the case of ores of a cheaper metal like lead, so that nowadays Peru exports few ores except those of such metals as vanadium, tungsten, molybdenum, etc., which, on account of their considerable intrinsic value, are proportionately less affected by a rise in freights. It is worth noting that the production of coal has only increased from 283,860 tons in 1914 to 290,743 tons in 1915, whilst the imports have fallen from 139,312 tons to 55,662 tons, in spite of the increased development of the metallurgical industry, as just pointed out, the reason being that the use of petroleum to replace coal as a fuel is on the increase, the output of oil having risen 43·7 per cent. above that in 1914.

NATIONAL LABORATORIES AND INDUSTRIAL DEVELOPMENT.[1]

II.

A NATIONAL PROVING HOUSE AND STANDARDISING LABORATORY.

CERTAIN general principles seem to me essential to success, namely :—

(1) Standardisation and testing must, if they are to be of value, depend upon research, and be closely connected with it.

(2) While there must be the closest union between the testing authority and the trade concerned with the production of the goods to be certified, the authority should not be dependent on the trade for financial support, and while the wishes of the trade as to the standards to be attained must be fully considered, the executive of the testing institution should be an independent authority.

Testing must go hand in hand with research. For, in the first place, research is necessary in order to set up the standards required. Take, for example, our standards of length. The yard or the metre is the distance between two marks on certain standard bars very carefully preserved. They are both arbitrary standards, it is true, and it is clearly of the greatest importance that they should be invariable. Do we know that this condition is secured, and, if so, how do we know it? Materials certainly alter their dimensions with changing temperatures, and possibly also with time; for standard work we must know the temperature at which we make our comparisons, and this need leads at once to the investigation of the methods of measuring temperature and of the amounts by which various materials change in size with changes of temperature. A wide field of investigation opens directly; temperatures are measured by thermometers. How are the various kinds of thermometer connected? Do a mercury thermometer and a gas thermometer give the same results? Is the glass of which an ordinary mercury thermometer is made of importance? Or, again: To what extent is the length of a yard measure of brass or steel dependent on the temperature? Can we find a material less sensitive to temperature changes than the platinum-iridium alloy of which the standard metre is made? And so on. The investigations necessary before we can standardise our yard measure have called for much research. But, again, what security have we that even if we keep the standard with the greatest care and make our comparisons under the most favourable conditions of temperature, its length is invariable? Is the metre the same length now as when it was first deposited at the Bureau des Poids et Mesures at Sèvres? To answer this question a research of great difficulty was carried out at Sèvres by Michelson when he compared the length of the metre with the wave-length of light under certain specified conditions. There are cogent reasons for supposing that to be an invariable quantity.

At the laboratory during the past two years we have tested vast numbers of gauges and the improvement in manufacture has been very marked; this has been reached only by careful investigation into each cause of error by attention to small details, and by research into methods of measurement with a view to their simplification so that they could be used in the workshop, and to improvement in accuracy so that the results obtained were not vitiated by errors in the method of obtaining them.

A visit to the gauge-testing-room of the National Physical Laboratory will show anyone how closely research and standardisation go together, how hopeless it would be to try to run a standardising laboratory apart from research. Or, again, to take an example from another department of science. Ohms and volts and amperes are nowadays familiar words; you measure the one with a Wheatstone bridge, or more probably with an ohmeter, you read off the others in a voltmeter or an ammeter. But the definitions of these quantities are highly technical and scientific.

Do you realise what research has been required before our present practical system of making electrical measurements was evolved, and how much you owe to that research? Compare the rate of advance of the electric motor and the steam engine.

The work of the Engineering Standards Committee has been of untold advantage to the country. At every step of that work the committee has kept in close touch with scientific principles, and researches of the most varied character have been carried out, and are being carried out now, with the view of determining what standards to set up and what tests to prescribe.

Nor is it enough to say that much of this has been done and need not be carried further; the principles on which ammeters and voltmeters are made have been thoroughly investigated, the optical laws with which telescopes and lenses must comply are well known; lay down your tests and specifications, and train observers, analysts, and testers to enforce them, and you have done all.

Stagnation and death, not life and progress, lie that way. It is not our object merely to apply with rigid fairness the laws laid down, and to be pleased rather than otherwise, like the mythical examiner, when we "plough" them every one. The standards set must be reasonable, but they must tend to raise the quality of the product tested. Recurring defects must be watched and investigated, and the tests modified to prevent

[1] Abridged from two lectures delivered at the Royal Institution on February 26 and March 5 by Sir R. T. Glazebrook, C.B., F.R.S. Continued from p. 77.

them; you must gain the confidence of the manufacturer and lead him to realise you are out to help him, and that you really know something, probably more than he does, of the strength and weakness of his goods. Nearly all Englishmen are anxious to maintain the reputation of their country, and welcome fair tests which show up bad work and make for its improvement. Our statistics show the improvement that is produced by tests properly carried out.

So much, then, for my first contention, that research and standardisation must go hand in hand; the truth of the second, that the testing authority should be independent of the manufacturer, is, I think, obvious. It is necessary to give confidence.

A certificate has but little value, even if it states the truth and nothing but the truth, unless it comes from an absolutely impartial source. If I bear witness of myself, my witness is nothing. To the old customers of a well-established firm the assurance of the firm is sufficient; a stranger looks for some independent evidence before he accepts as true all the claims made by the man who desires to sell his latest production as something far superior to all else on the market.

Impartiality is the first attribute of justice, and the suspicion that the judge may be swayed by something besides the strict merits of the case is fatal. Again, it is necessary for the good of the manufacturer. False praise is dangerous to the recipient. The man who relies on the verdict of a too friendly critic may easily fail to maintain the high quality of his products and find himself outstripped by one who has been spurred to effort by fair and judicious criticism.

A testing laboratory controlled by an association of manufacturers for the advancement of their trade is of much less value, both to them and to the country, than one in which the ultimate decisions rest with an independent authority. Of course, the standards to be worked to must be determined in closest co-operation with the trade. No specification is ever adopted by the Engineering Standards Committee until it has been fully discussed at meetings at which the trade is fully represented; in no case is the decision as to whether an article comes up to the standard left to such a meeting, and this has had an important bearing on its success. At the laboratory we have advisory committees on various matters. Executive powers rest with the Executive Committee or with the director acting under the instructions of that committee. He signs all the certificates, and is responsible only to the committee, and this seems to me the proper plan.

[The lecturer then proceeded to describe and illustrate on the screen some of the principal tests now carried out at the laboratory.]

Having now dealt with the test work at the laboratory, and the method of procedure, let us turn to the future. Is the work of value? If so, what steps have been taken to make it of more value still, to increase its range, and to widen its influence? Are further steps desirable, and, if so, what should they be?

Its value is, I think, recognised; the recent growth in many branches of our work, besides that of testing gauges for engineers, is evidence of this; the proposals to establish standardising laboratories in various centres of industry point in the same direction. Engineers are coming to recognise more and more the importance of interchangeability, the advantage of working to limits, the gain in producing power—combined, I fear, with deadly dullness in much of the work—secured by the standardisation of parts.

Here, I think, a word of caution is necessary. Local standardising institutions are desirable in certain cases; local standards are most undesirable. I am not sure how many wire gauges used in the sale and purchase of wire and thin metal sheets there are. In a recent list I saw enumerated some six or eight, each with its own tolerances, or in many cases with no tolerances at all; each has been introduced to fill a need, but with no thought for other needs. There is a risk, I fear, that the establishment of local testing laboratories, unless care is taken to connect them with some central institution responsible for maintaining their standards and co-ordinating their methods, may tend to perpetuate like anomalies. There is already, as many of us know, a standard inch and an "Enfield" inch; we do not want Manchester, Leeds, and Birmingham inches.

Transit is easy, and the delay involved in sending goods to a central institution need not be great; the uniformity of results secured in this manner is worth much. Where this cannot be done there should be some organisation devised to keep the standards employed in all parts of the country alike within agreed limits, and to maintain this connection with the results of research.

The increase in the number of clinical thermometers has already been mentioned. Tests on optical instruments of all kinds are growing, and steps have been taken to add to the staff and improve the facilities for handling these.

The quantity of glassware used in chemical laboratories throughout the country is enormous. In pre-war days this was almost all of German manufacture, and much came into the country with Reichsanstalt certificates. English manufacturers have taken up the question, and are now prepared to offer large supplies, and a scheme has been arranged for its standardisation and the issue of certificates. This is the outcome of discussions of a committee on which were representatives of the Department, the manufacturers, the users, and the laboratory. The limits of error for the various classes of articles have been provisionally fixed, and a schedule of fees settled which the makers think reasonable, and it is hoped will in time enable the work to be carried on without loss. For the present a house has been secured at Teddington, and is being equipped, in which the testing can for the time go on —a certain amount of this class of work has always been carried out at the laboratory. Additional buildings are to be erected, and the scheme put on a permanent footing.

The quantity of the various articles is very large, and it is not necessary that all should be tested to the same limits of accuracy, nor would it be possible to send them all to the laboratory. This difficulty will be met by having two classes of goods treated differently. For work of the highest accuracy it is necessary that the articles should be sent to Teddington and be tested individually. Those that pass the tests will constitute Class A, and receive the laboratory mark. The vast majority will be dealt with at local centres organised by the laboratory and manned, at least so far as the more responsible positions go, by members of the laboratory staff. These centres will, in some cases, be at the large works; in others it is hoped to interest the local universities or technical colleges. At the head of each will be the N.P.L. inspector, who will be free to visit the works, inspect the methods of manufacture, and select for test from each batch such articles as he thinks fit. So long as the methods remain satisfactory and the goods come up to standard, the firm will be licensed to mark the articles in some distinctive way.

A fee will be charged for each article tested at the laboratory. In the case of the articles inspected or tested in bulk, it is proposed to cover expenses by a royalty reckoned on the numbers produced, which would be charged for permission to use the trade-mark.

Such a scheme, it is clear, requires the cordial co-operation of the makers and the inspecting authority.

This we have already been promised, and while the conditions of test and the limits permissible are settled after consultation with the manufacturers, the enforcement of those conditions and the power to refuse the licence rest with an independent body. Such a plan, it seems to me, is far preferable to the alternative under which an association of the manufacturers would run its own testing laboratory.

A similar scheme is clearly applicable to other industries. For engineering work the standards of the Engineering Standards Committee are mostly adopted. The laboratory holds the standard screw gauges of the committee as well as the rail templates and other similar standards. Some organisation whereby standards employed locally for testing purposes are controlled by the laboratory and kept in close correspondence with those at Teddington ought not to be difficult to devise, and would secure much of what is needed, though with screw gauges at present identity of the method of testing rather than of the standard of comparison is what is difficult to secure.

Or, again, with electrical instruments, supply meters, ammeters, voltmeters, and the like can be, and are, sent to the laboratory, and where high accuracy is required this must be done. Very large sums depend now on the measurement of the energy supplied from central stations to big works, tramway systems, collieries, and other large installations, and very high accuracy is needed. This, too, is true in the case of acceptance tests of large machinery. The necessary accuracy can be obtained only in a properly equipped laboratory, and, indeed, in the case of meters, an individual test is always necessary, but where the type has been tested and approved the individual tests could be carried out by inspectors at the works, or at some convenient local institution. And there are many pieces of apparatus and small plant which could be dealt with in a similar manner to the chemical glassware.

The Engineering Standards Committee has specified the performance tests for motors and dynamos requisite before the term "British standard" can be applied to them. It is clearly impossible to expect that every small motor should have been put through these tests. It would be quite simple to arrange that some limited number of the type were tested out at the National Physical Laboratory, that steps were taken, by inspection and occasional tests, to secure that in subsequent production the same standard was attained; and, so long as this was done, to license the manufacturer to put the E.S.C. mark on his machine, and call it a "British standard machine."

The process can be extended to other electrical products; it has already been suggested for lamps, and four years ago I had good hopes that some action of the kind would be taken—1914 stopped it for the time. I would urge that now is the time to develop a scheme of the kind so that we may be ready when once more peace reigns on earth among men of good will.

The scheme is a large one, one that as director I cannot hope to see fully developed. It is enough perhaps for me to have indicated how the laboratory may grow, both as a National Research Laboratory and as a National Proving House and Standardising Laboratory.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MISS PHYLLIS M. BORTHWICK, lecturer in physics at the Ladies' College, Cheltenham, has been appointed assistant-professor of physics and chemistry at the Lady Hardinge Medical College for Women, Delhi.

ON the first Saturday of each month from May to October, at 3.30 p.m., free public demonstrations on practical bee-keeping will be given in the Horniman Gardens or the Museum, Forest Hill, S.E., by Mr. W. H. Prior, of the Kent and British Bee-keepers' Associations.

M. PAUL OTLET'S article in the *Revue générale des Sciences* for February last on "The Future of the International Catalogue of Scientific Literature" contains a short account of the foundation of the catalogue and some proposals for its future development. The vast experience which M. Otlet has acquired at the International Institute of Bibliography at Brussels entitles his opinion on such a subject to respect. It is, however, difficult to reconcile his statement that "before the war the German Government had decided to withdraw from the International Catalogue" with the fact that at the meeting of the International Council of the catalogue held in London on June 11 and 12, 1914, about six weeks before the war broke out, the representative of the German Government, Dr. Uhlworm, proposed the resolution:—"That the International Catalogue of Scientific Literature shall be continued during the years 1916–20," which was adopted by the council. M. Otlet would like to see the International Catalogue extended to include technology, industrial sciences, medicine, agriculture, social sciences, philology, literature, the fine arts, history, geography, philosophy, and religion. In view of such extension he thinks the work of the regional bureaux in the various co-operating countries should no longer be controlled by scientific societies, but undertaken by the authorities of the National Library in each country. M. Otlet suggests that in view of the continual increase in the number of scientific journals, authors should agree not to publish original papers in any periodical that was not included in a list drawn up by mutual agreement. In order that subscribers to the catalogue may be in possession of the latest information, M. Otlet recommends that the index-cards received at the Central Bureau should be printed and issued at once. As each volume appeared, the cards corresponding with that volume would be destroyed by the subscribers, who need keep only such cards as had not yet been published in a volume.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 21.—Sir J. J. Thomson, president, in the chair.—Dr. C. **Chree**: The magnetic storm of December 16–17, 1917, as recorded at Kew and Eskdalemuir Observatories. The magnetic storm of December 16–17, 1917, was of very considerable though not outstanding magnitude. It commenced between 8h. and 9h. on December 16, and had not wholly subsided before the afternoon of the following day. Attention is directed in the paper to the curves for the twenty-four hours commencing at 8h. on December 16. The most active period of disturbance was between 15h. (3 p.m.) on December 16 and 4h. on December 17. A prominent feature in the curves was a succession of oscillations of periods averaging about twenty minutes. There were also, especially at Eskdalemuir, some very large short-period oscillations. The paper compares the oscillations recorded at the two observatories, and gives estimates of the rate of change of the magnetic elements during the most rapid movements. The amplitude and rapidity of the changes proved to be much greater at the more northern station.—E. A. **Owen**: The absorption of X-rays. (1) The absorption coefficients of a number of substances for a radiation of wave-length $0{\cdot}586\times10^{-8}$ cm. (the α-line of palladium) have been determined, and the values obtained confirm those of Bragg and Pierce in the case of elements used in common. (2) The atomic fluorescent absorption coefficient is proportional approximately to the fourth power of the atomic number of the absorber. (3) The following relation exists between the atomic fluorescent absorption coefficient, atomic number of the absorber, and the wave-length of the radiation absorbed, $fa = CN^4\lambda^3$, where C is a constant over certain ranges, but changes abruptly at critical points. This relation is independent of the scattering coefficient; it refers only to the loss of energy of X-radiation by the production of corpuscular radiations and the fluorescent X-radiations that accompany them. (4) Calculations based on the above general relation show that the molecular total absorption coefficients of different substances observed by Auren with radiation of wave-length $0{\cdot}35 \times 10^{-8}$ cm. may be deduced very approximately from the atomic total absorption coefficients obtained for different elements with radiation of wave-length $0{\cdot}586 \times 10^{-8}$ cm. if the coefficient of scattering be assumed to have a constant value of 0·2 for all elements from hydrogen to bromide for both these radiations.

Linnean Society, March 21.—Sir David Prain, president, in the chair.—Miss B. Muriel **Bristol**: A Malayan form of *Chlorococcum humicola* (Naeg.), Rabenh. Cultures were made in October, 1915, from about sixty specimens of soil, the observations now reported being obtained from Kajang, near Kuala Lumpor, Malay States, after about two years in a closed specimen-tube; the soil was placed in a mineral-salt solution and allowed to remain under the room-temperature. In June, 1916, growth of the soil-alga began, and its life-history is now set out, tracing it from the vegetative cells, which are solitary or congregated into globular clusters. Later, multiplication by zoogonidia was observed, with their fusion forming zygotes, also by aplanospores, but true vegetative division does not take place. The same alga was found in soil-cultures from English localities, in some cases of considerable age. Thus a sample from Rothamsted Experimental Station taken in 1856 yielded the alga, but a sample taken in 1846 did not, so that presumably a period of seventy years marks the extreme limit of revival.

Zoological Society, March 19.—Dr. A. Smith Woodward, vice-president, in the chair.—Miss Maude L. W. **Cleghorn**: First report on the inheritance of visible and invisible characters in silkworms.

Mineralogical Society, March 19.—Mr. W. Barlow, president, in the chair.—Prof. E. S. **Federov**: Graphical operations with four independent variables. *A propos* of Boeke's suggestion of the use of multi-dimensional geometry for such operations, with special reference to the case of the chemical constitution of tourmaline, the author remarks that he had already put forward a similar suggestion, without, however, making use of imaginary dimensions. A system of points is replaced by a system of vectors, and in this way, since each end of a vector has two co-ordinates, a relation between four independent variables may be expressed graphically. Different series of vectors of the first order give rise to vectors of the second order, and they in their turn to vectors of the third order. Certain special cases were discussed.—Prof. R. P. D. **Graham**: Lattice-like inclusions in calcite from North Burgess, Ontario. The calcite, which is almost invariably twinned about $e(01\bar{1}2)$, contains numerous fine needles, arranged parallel to the edges of the rhombohedron e, of a hydrous magnesium silicate, which chemical analysis showed to correspond with the formula $5MgO.6SiO_2.4H_2O$, which is usually assigned to the mineral spadaite. Since the needles are only slightly acted on by cold dilute acid, they remain behind in the form of a lattice on dissolution of the calcite. Other included minerals are pyroxene, quartz, titanite, and pyrites. The source of the solutions which supplied the magnesium silicate was discussed.—Dr. J. W. **Evans**: Linear rock-diagrams. The different types of linear or variation diagrams, in which the chemical constituents of different rocks are represented by vertical distances, were reviewed, and the use of modifications to indicate the probable mineral compositions was proposed. Each rock is represented by two diagrams. In the first or alumina diagram, distances representing the molecular proportions of (1) the potash, (2) the potash and soda, and (3) the potash, soda, and lime in each rock are measured vertically upwards from the base line, and corresponding points for different rocks are connected by continuous lines. At the same time distances representing (4) the alumina, (5) the iron oxide, and (6) the magnesia are measured on the same lines in the same manner, and are connected by continuous lines. Not only will this diagram indicate the proportions of the constituents, but also the position of the points on line (4) relative to those on lines (2) and (3) will indicate the probability of the occurrence of minerals dependent on the amount of alumina. If (4) is higher than (3), andalusite, cordierite, or mica may be expected, as well as hypersthene, all the lime being converted into anorthite. If (4) is less than (3), diopside, augite, or the corresponding amphiboles will probably be present, and, if it is less than (2), minerals of the ægirine type may be found. In the second, or silica, diagrams the lowest series of points shows the amount of silica required by the bases of a rock for the formation of leucite, nepheline, anorthite, wollastonite, and olivine, the second series the additional silica necessary to form orthoclase and albite, and the third series the amount required to convert the olivine into hypersthene, while the fourth line represents the amount of silica actually present. The position of the last relative to the others will throw valuable light on the silicates that may be expected, though allowance must be made for the influence of the bases on one another. For instance, the presence of the constituents of wollastonite will call for a higher silicification of part of the olivine to form a monoclinic pyroxene or amphibole at the expense of the felspars.

MANCHESTER.

Literary and Philosophical Society, March 19.—Mr. W. Thomson, president, in the chair.—Prof. G. Elliot **Smith**: Race, character, and nationality. The influences of race and heredity, geographical circumstances, and language, though potent in various directions to affect the character and achievements of individuals and to play a part in the development of the true spirit of nationality in a community, are not the chief factors. The personal experience of each individual, his social environment, and especially the traditions of his community, shape his outlook on life, determine his character, and give specific directions to his inherited aptitudes. The most powerful forces that mould nationality and weld together a heterogeneous collection of people of varied origin, abilities, and traditions consist of historical circumstances which provide the community with common aims and aspirations, common traditions and social fashions, common trends of thought and modes of behaviour. Such circumstances play a more vital part than mere race or hereditary aptitudes in the development of the spirit of nationality.

PARIS.

Academy of Sciences, March 18.—M. Paul Painlevé in the chair.—The president announced the death of Lord Brassey, correspondant of the Academy for the section of geography and navigation.—P. **Termier**: Contribution to the knowledge of the tectonics of the Asturias: anomalies at the contact of the Coal Measures and the Arnao Devonian.—P. A. **Dangeard**: The nature of the chondriome and its *rôle* in the cell. Current views on the nature and function of the chondriome are questioned, and new facts based on a method of staining with cresyl-blue are given. This stain can be applied in such a manner that there is no interference with the life of the cell. It is shown that, contrary to the generally accepted view, the chondriome of the cell is altogether independent of the plastidome.—E. **Ariès**: A formula giving the saturated vapour pressure of a diatomic liquid. An extension of the method described in previous communications for monatomic liquids. Chlorine and carbon monoxide are worked out as examples.—M. G. Kœnigs was elected a member of the section of mechanics in succession to the late M. H. Léauté.—M. T. **Beritch**: The convergence and divergence of series with real positive terms.—A. **Buhl**: The intervention of the geometry of masses in certain theorems concerning algebraic surfaces.—L. **Schlussel**: The measurement of rapid and irregularly variable dynamical actions.—B. de **Fontviolant**: New theory relating to the effects of the wind on bridges.—D. **Eydoux**: The movements of water in equilibrium pipes. —A. B. P. **Leme**: A new method of quantitative analysis. Suggestion for a new arrangement of spectrograph for quantitative work.—A. **Mailhe** and F. de **Godon**: A new method of preparation of monomethylaniline and dimethylaniline by catalysis. A mixture of the vapours of methyl alcohol and aniline is passed over alumina at a temperature between 400° and 430° C., when a mixture of monomethylaniline and dimethylaniline is obtained, containing only traces of aniline. By a repetition of the process with addition of methyl alcohol, dimethylaniline is obtained. The new method has the following advantages over the process in current use: the aniline may contain water and the methyl alcohol need not be specially purified from acetone; also, the use of autoclaves and high pressures is unnecessary.—E. **Léger**: The action of hydriodic acid upon cinchonine and on its isomers, cinchonigine, cinchoniline, and apocinchonine.—L. **Gentil**, M. **Lugeon**, and L. **Joleaud**: The existence of a Triassic sheet in the Sebou basin, Morocco.

BOOKS RECEIVED.

Medical Electricity. By Dr. L. Jones. Seventh edition, revised and edited by Dr. L. W. Bathurst. Pp. xv+588. (London: H. K. Lewis and Co., Ltd.) 15*s*. net.

The Nature of Solution. By H. C. Jones. With a Biographical Sketch by Prof. J. E. Reid, and Tributes by Profs. Arrhenius, Ostwald, and Woodward. Pp. xxiii+380. (London: Constable and Co., Ltd.) Price 12*s*. 6*d*. net.

The Megalithic Culture of Indonesia. By W. J. Perry. Pp. xiii+198. (Manchester: At the University Press; London: Longmans, Green, and Co.) Price 12*s*. 6*d*. net.

Aeronautics in Theory and Experiment. By W. L. Cowley and H. Levy. Pp. xi+284. (London: E. Arnold.) Price 16*s*. net.

Essays in Scientific Synthesis. By Eugenio Rignano. Pp. 254. (London: G. Allen and Unwin, Ltd.) Price 7*s*. 6*d*. net.

Lecithin and Allied Substances: The Lipins. By Dr. H. Maclean. Pp. vii+206. (London: Longmans, Green, and Co.) Price 7*s*. 6*d*. net.

Thirty-first Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1909–10. Pp. 1037. (Washington: Government Printing Office.)

DIARY OF SOCIETIES.

MONDAY, April 8.

Royal Geographical Society, at 8.30.—The Future of the Albanian State: Capt. J. S. Barnes, R.F.C. (leave permitting).

Aristotelian Society, at 8.—Value and Existence: Dr. F. C. S. Schiller.

TUESDAY, April 9.

Royal Institution, at 3.—Scientific Signalling and Safety at Sea: Prof. J. Joly.

Institution of Civil Engineers, at 5.30.—The Derwent Valley Water works: E. Sandeman.

Zoological Society, at 5.30.—Head of the Charasinid Fish, *Hydrocyon goliath*: Dr. G. A. Boulenger.—The Variation of the Pit-Viper, *Lachesis atrox*: Miss J. B. Procter.

Röntgen Society, at 8.—The Silvanus Thompson Memorial Lecture: Sir Ernest Rutherford

WEDNESDAY, April 10.

Royal Institution, at 3.—Scientific Signalling and Safety at Sea: Prof. J. Joly.

British Association Geophysical Committee (Royal Astronomical Society), at 5.—Earthquake Waves: Prof. H. H. Turner and Dr. G. W. Walker.—Earthquake Frequency: R. D. Oldham.

THURSDAY, April 11.

Royal Institution, at 3.—Experimental Psychology: Lt.-Col. C. S. Myers.

Institution of Electrical Engineers (Cancer Hospital, Fulham Road), at 6.—Joint Meeting with the Electrical Section of the Royal Society of Medicine.—Papers on Medical Electricity.

Institution of Mining and Metallurgy, at 5.30.—Presidential Address: Hugh F. Marriott.

Optical Society (Imperial College of Science and Technology, South Kensington), at 8.—The Balsam Problem: J. W. French.

FRIDAY, April 12.

Royal Institution, at 5.30.—Absorption and Phosphorescence: Prof. E. C. C. Baly.

Royal Astronomical Society, at 5.

SATURDAY, April 13.

Royal Institution, at 3.—Musical Instruments Scientifically Considered: Prof. E. H. Barton.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., Ltd.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: Phusis, London.
Telephone Number: Gerrard 8830.

THURSDAY, APRIL 11, 1918.

A SURVEY OF EXPERIENCE.

Elements of Constructive Philosophy. By Dr. J. S. Mackenzie. Pp. 487. (London: G. Allen and Unwin, Ltd.; New York: The Macmillan Co., n.d.) Price 12*s*. 6*d*. net.

THIS is a very pleasant and very instructive book. It is like a series of conversations with a thinker of great versatility and great learning, extending over the whole range of logical and metaphysical speculation. Dr. Mackenzie is definite without dogmatism, and earnest without fanaticism. And he is suggestive on all points that he touches.

The treatise falls into three parts. The first "book" is devoted to logical discussions; the second to metaphysic—explaining the principal categories by which we conceive of nature and spirit; the third to what might be called ultimate cosmology, to such problems as the unity and perfection of the universe, the survival of the individual, and the relation of time and eternity.

In book i., beginning from belief, which the author treats as a mode of selection, and pointing out that the selection cannot be arbitrary, he passes through an account of judgment and of the laws of thought to a first analysis of the controlling factor, the experience of objective orders. Logic he takes to be the general theory of implication, and all implication—that is, the essence of all inference and judgment and belief—depends upon the recognition of objective orders. To these he devotes a chapter, referring to Driesch's "Ordnungslehre" as the most elaborate treatment of the subject, and pointing out that any principle which has some possibility of continuous application may be taken as a principle of order. There are orders of all kinds, from the numerical to the moral order or order of values, and, as M. Bergson has suggested, it is doubtful whether the conception of disorder can mean anything but the absence of some particular order which we chose to expect. In referring to theories of knowledge, the author well explains that the antithesis of pluralism and cosmism is much more significant than that of realism and idealism, which need not necessarily be an opposition at all.

In book ii. the treatment of causation is of interest. In general agreement with Mr. Russell, Dr. Mackenzie holds that it amounts pretty much to the unity of different things as connected by relations that have some regularity. Cause tends to pass into a principle, and effect into a detail. Whether on this ground the distinction between cause and effect can be maintained may seem doubtful.

An important chapter in this second book is that dealing with valuation. Attempting to arrive at a conception of intrinsic value, the author concludes that it must be identified with truth, beauty, and goodness, and that all else can have value only as instrumental to these.

From this it is interesting to pass to the conception of ultimate reality in book iii., where the problem of reconciling time with the unity of the cosmos (the term universe is applied to units within the cosmos) is attempted on the lines of cycles or histories presenting themselves as dreams which have constancy within an eternal whole, as a play of Shakespeare exists in its own time within the imagination of the poet or reader. The point of the metaphor is that it admits time *into* the cosmos, but the time so admitted is not a time of the cosmos. And the eternal characters of the cosmos—truth, beauty, goodness—would thus appear in time, without being mere transient events. There is an interesting reference to Oriental sources for such views, and actually a diagram of the upward and downward path. Our fear about all such doctrines is that the paths and cycles may be imagined as divorced from each other and from the characters of the universe. They then become illusions, and the cosmos a "thing-in-itself." After all, it is in a woman's heart or a nation's spirit that we find what brings us nearest to cosmic reality.

It is part of Dr. Mackenzie's temperateness that he promises us from philosophy only hope, not conviction. There is truth in this position, so far as particular expectations are concerned. But yet it recalls to us a technical point about the "Laws of Thought." For him they are not based on the nature of reality: you cannot judge at the beginning whether reality will prove self-contradictory, but only at the end of your inquiry. This is more difficult than it seems. Unless you start from the coherence of reality, you can never get to it. You cannot separate thought from assertion about reality. If things may be both this way and that, and thought can be only one way, thought is obviously false, and you can make no step towards knowledge. "Make a hypothesis, and test it by facts." But if things being one way does not exclude their being the other way, there *are* no facts.

Attention should be directed to Dr. Mackenzie's observations on Mr. Russell and the new realists. His view of Prof. Nunn's theory of external objects seems reasonable. The double pitch of a tone, as heard by a stationary and a receding ear, certainly belongs to it. But neither pitch exists in the absence of the corresponding ear.

BERNARD BOSANQUET.

PRACTICAL ASPECTS OF PRUNING.

The Principles and Practice of Pruning. By M. G. Kains. Pp. xxv+420. (New York: Orange Judd Company, 1917.) Price 2 dollars net.

THE author of this work makes the following statement in his introduction: "Pruning demands a knowledge of plant physiology. Unless the pruner has a working knowledge of how plants grow, he will be unable to prune intelligently and to secure the desired results." It is a matter for regret, therefore, that the chapter on plant physiology, with which the book opens, should be inferior to the later chapters, which deal in a clear and useful manner with the practical aspects of pruning. Readers with little or no knowledge of plant physiology would, however, be apt to find the treatment of the subject in this chapter somewhat involved and confusing.

In the succeeding part of the book the photographs of the branches of fruit trees are extremely good, and are accompanied by very clear and simple explanations of the methods of branching. These should prove useful to fruit-growers and to teachers of both horticulture and Nature-study. The pruning of nursery stock, of young and of mature trees, of bush fruits, and of ornamental shrubs is fully dealt with. A chapter on the "rejuvenation of neglected trees" may be mentioned, as it is a subject which should be of interest to some owners of small private orchards who are anxious to obtain the best possible yields from their trees. The author considers that in the case of apple, pear, and sweet cherry trees specimens fifty to seventy-five years old may be profitably "rejuvenated," but that in the case of plums and sour cherries it will be better to destroy the trees and to re-plant.

"Practical tree surgery" is another aspect of the subject which the author has fortunately included in the book, for frequently trees which are specially valuable on account of their position or association could be saved for long periods from decay by a little skilled care and attention. Some hints which might be useful to the authorities responsible for the care of street trees are given, and a model contract which should put "commercial tree-surgery on a basis that will tend to eliminate fakers" is outlined (p. 401).

The book contains numerous references to the experimental work on pruning which has been carried out in this country and in America, and summaries of such experimental trials and of their results are given. These accounts are both fuller and clearer than is usual in abstracts of this kind. As work of this nature has in the majority of cases been published only in the bulletins of the American experiment stations or in horticultural periodicals, it is frequently difficult to trace, and its inclusion in the book is a feature of great value.

In conclusion, it may be added that the book has a good index and more than three hundred excellent illustrations.

OUR BOOKSHELF.

Comment Economiser le Chauffage Domestique et Culinaire. Par R. Legendre et A. Thevenin. Pp. 123. (Paris: Masson et Cie, 1918.) Price 1.25 francs.

The question of economy in the use of fuel for general domestic heating and cooking is of no small importance in relation to the general economy of fuel rendered imperative in France by the conditions arising from the war. This small book, issued at a low price under the auspices of the Ministère de l'Armement et des Fabrications de Guerre, is primarily intended to indicate practical methods of attaining economy in the domestic use of fuel, without pretence at scientific treatment of the subject, although there is an excellent section on the principles of combustion and the heat values of fuel.

In the earlier sections the various ordinary fuels are described and also the supplementary fuels, such as peat, lignite, sawdust, tan, etc., briquettes, and simple methods of briquetting small coal. The advantage of using substitutes to the utmost extent to relieve the demand on the better fuels essential for industrial purposes is emphasised.

The second section deals with domestic heating appliances, and, besides describing various forms of fireplaces, stoves, etc., deals with the principles of heating by radiation, conduction, and convection. There is a useful section on smoky chimneys. The final section is concerned with cooking, stress being laid on the advantages of the Norwegian oven. Each section concludes with a summary of possible economies and brief directions as to their realisation. An abbreviated issue of a similar character would well be worth consideration in this country.

The Pasteurisation of Milk from the Practical Viewpoint. By C. H. Kilbourne. Pp. iv+248. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 6s. net.

The pasteurisation of milk consists in heating the milk to a temperature between 140° and 160° F., the milk being maintained at 140° for not less than twenty minutes or at 160° for not less than one minute. By this treatment disease germs which may have gained access to the milk are destroyed, as well as a large proportion of the bacteria commonly present in milk, whereby its keeping qualities are lengthened. In the United States pasteurisation has been very largely employed, and this little book gives a capital survey of the installation, operation, and control of pasteurising plants. The author speaks from first-hand knowledge, having been chief of the Division of Pasteurising Plants, New York City Department of Health. The various types of pasteurisers are sufficiently described, and this section is illustrated with a number of diagrams of various plants. The cleaning and cooling of milk, the cleaning of containers, and home pasteurisation are also dealt with, the efficiency of various apparatus is discussed, and the changes induced in milk by pasteurisation are described.

The book can be recommended as a thoroughly trustworthy guide on the subject of pasteurisation, useful alike to the student of hygiene and to the practical dairyman. 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.]*

The Eötvös "Tour de Force."

MAY I add to my article in NATURE of March 21, on the revolving balance of Baron Eötvös, that the method lends itself to determine the mass of the earth, or, more directly, the Newtonian constant of gravitation, with the same simplicity as it does to find the rotation of the earth. For this purpose it is merely necessary to place a large mass above the balance, say at the north end, and below the balance at the south end. Then if the direction of rotation is such that the north end is moving in the same direction as the earth the gravitational couple will act in the same direction as the $4Vv$ difference of centrifugal force, whereas if it turns in the opposite direction, the gravitational couple will be opposed to the centrifugal couple. If the large masses of radius c are spherical and are made of material of density d, and the fictitious distances of their centres vertically above and below the small masses at the ends of the balance-arms are also equal to c, the arm lengths being r, then the time of rotation necessary to make the one action equal to the other is given by the equation—

$$T=\frac{48\Omega}{Gd}\frac{r}{c}\cos^2\phi.$$

Making provisionally $r=c$, and taking for d the density of lead, the time T comes out as thirty-one minutes, which, I fear, is much greater than that which could be realised as a free period. If, however, the period were one minute, the gravitational couple would add or subtract 1/31 part of the centrifugal effect, according to the direction of rotation, or the ultimate deflections in the two cases would have the ratio 15:16, a difference which might be observable. By fictitious distance I mean the equivalent distance vertically above or below the centre of the small mass m at which the centre of the large mass may be imagined acting on the small masses with a cosine distribution of force. Actually it would have to be larger and further away. This could more readily be determined in any particular case by arithmetical treatment than otherwise.

I have been considering in some detail the best way of constructing an Eötvös *tour de force*, if I may be allowed so to call it, with a view to the utmost possible delicacy, and as I have all the material, I am hoping to set one up in a cellar in the country admirably adapted to the purpose in such time as I can glean from other occupations.

C. V. BOYS.

The Motion of the Perihelion of Mercury.

IN NATURE for March 21 Sir Oliver Lodge suggests that the unexplained part of the motion of the perihelion of Mercury may be attributed to the action of a resisting medium. Such a medium would not necessarily produce any effect on the mean distance of a planet, for such an effect depends entirely on the relative velocity, and it is probable that the medium would revolve with the planets. The principal effect of the medium would be to reduce the eccentricity, and de/dt would contain e as a factor. There would be no motion of the perihelion if e were small enough. Any motion of this could arise only if the eccentricity were considerable, and thus would contain it as a factor. Hence $d\varpi/dt$ and de/dt would be of the same order. Now the observed anomalous variations of ϖ and e in a century are $43''$ and $-0.88''$, so that they are of different orders, and therefore cannot be due to a resisting medium.

Or, again, consider the density needed to produce the effect. The average resultant velocity of Mercury relative to the medium is of the order of the eccentricity multiplied by the planet's mean orbital velocity, or about eight kilometres per second. If ρ be the density of the medium, a the radius of Mercury, U this relative velocity, and M the mass of the planet, the retarding force would be nearly ρa^2U^2, and de/edt would be of the order $\rho a^2U^2/MU$. Substituting for all these quantities, except ρ, their known values, we see that ρ must be of the order 3×10^{-11} gm./cm.^{3}, while the maximum density consistent with the observed luminosity of the Zodiacal light is only about 2×10^{-17} gm./cm.^{3}. To account for the motion of the perihelion would, of course, require a still greater density.

Many recent writers on this subject have treated the discordance in the motion of the perihelion of Mercury as if it were the only unexplained perturbation in the solar system. Yet there is an unexplained advance of the node of Venus of the same order of magnitude, the motions in a century being $43''$ and $10''$ respectively. The latter estimate is admittedly subject to greater uncertainty, but it is 3·5 times its mean error, and the probability that so large a discrepancy is accidental is only about 0·0004. Now, whatever may be the effect of departure from simple Newtonian dynamics, it cannot alter the plane of an orbit, which can be done only by the attraction of other matter, or to a negligible extent by a moving resisting medium. It is found that a distribution of gravitating matter that would represent the motion of the node of Venus would necessarily account also for the whole of the discrepancy in the perihelion of Mercury, so that departures from Newtonian dynamics to explain the latter make the former impossible to account for. It is, of course, possible that the excess motion of the node of Venus may be due to errors of observation, but the probability against this is about 2500 to 1, and it must be admitted that any theory with such an *a priori* probability against it is open to very grave suspicion.

HAROLD JEFFREYS.

Bee Disease.

IN connection with the article on bee disease which appeared in NATURE of March 21, perhaps my experience with diseased bees may be of interest. I have subjected to microscopic examination the contents of the intestines and chyle stomachs of several dozen bees, all guaranteed by a professional lecturer in bee-keeping to be suffering at the time from the "Isle of Wight disease." In all cases the examination under the 1/12 immersion was conducted within five minutes after the bees had been killed. In no case did I find a trace of *Nosema apis*. In some there was a predominance of wild yeasts in the affected parts; in others again bacterial multiplication was very far advanced. It may, of course, be advanced that these particular bees were not suffering from the "Isle of Wight disease," but in view of the conclusion adopted by several competent biologists that *Nosema apis* has no causal connection with the "Isle of Wight disease," and also of the importance of the subject, further investigation is urgently needed. The impression left on the present writer was that *Nosema apis*, when found, was an accessory, and not a causal agent; and the fact that in practically all the observations of this disease that have been made in Scotland *Nosema apis* has been conspicuous by its absence supports this impression. It would appear that different causative agents produce the same symptoms; from the practical point of view, as the agents may be protozoa, or yeasts, or bacteria, we need more diagnostic data, for the method of combating the disease must necessarily depend on the nature of the micro-organism to be combated. DAVID ELLIS.

Royal Technical College, Glasgow, March 30.

THE object of the article on bee disease which appeared in NATURE of March 21 was to emphasise the fact that, though bees suffer from many diseases, the macroscopic symptoms are practically the same, and to claim that the only acceptable definition of "Isle of Wight disease" is the "disease caused by *Nosema apis*." As Mr. Ellis's experience would appear to support this contention, it is to be regretted that he should have received the impression that Nosema, when found, has no causal connection with the disease. The correct deduction would appear to be that, in spite of the guarantee of the professional lecturer on bee-keeping, the bees he examined were not suffering from "Isle of Wight disease." It would at any rate be interesting to know on what scientific data this guarantee was given. The conclusions in the last sentence of Mr. Ellis's communication are identical with those drawn in my article.

THE WRITER OF THE ARTICLE.

Prices of Scientific Apparatus.

THE method of advertising at present adopted by some of our scientific instrument makers is, I venture to think, open to serious objection. The prices mentioned are, it would appear, not the current prices at all. An addendum (printed in small type or in some other inconspicuous way) informs the public that, owing to the war, the prices quoted in the advertisement are subject to an addition of 10 or 20 per cent., and in some cases to as much as 33 per cent. Would it not be advisable to abandon entirely the publication of pre-war prices, and to quote instead the sums for which the various forms of apparatus are to be obtained at the time the advertisement meets the public eye? FREDK. J. BRODIE.

Loxley Road, Wandsworth Common, S.W., April 2.

COTTON-GROWING STATISTICS.

THE forecasting of the cotton crop, upon which depends one of the greatest industries of the world and in which Great Britain is especially interested, has settled into a mixture of reports based on a glance round a cotton field, a chat with a proprietor, and a combination of a few climatic notes which a Government department wisely issues for a farmer's guidance. It is all unsubstantial, but these reports are spread over the world and are used as a basis for business and speculation according to the credit any particular reporter may have at the moment.

It is not surprising that serious attempts are made to eliminate this casual method and establish a scientific basis in its stead. A short time ago a particular investigation conducted in Egypt necessitated the obtaining of a certain amount of data of the growth of the cotton plant. The collection of the data was carried out on scientific lines and evidently served its purpose. It was found, however, that the data and method used for this particular purpose gave indication that their use could be extended to the solution of a far more important problem, viz. forecasting with some degree of accuracy the flowering, ripening, and stages in the picking of the cotton crop. In other words, an estimate of the yield of the crop could be made several weeks before the cotton was ready for picking. The line of argument for this conclusion is fairly simple. The rate of the growth of the plant in height (stem growth) was considered to be, in some proportion, indicative of the rate of flowering; so that a curve of growth, compared with some standard growth curve, would indicate the rate of flowering three weeks before flowering commenced. The flowering curve, in its turn (with certain corrections), offered a ready means of estimating the number of bolls of cotton, or the amount of ripe cotton, that could be anticipated two months later. Forecasting on these lines became a scientific matter, and it held out a distinct promise of a wide field of usefulness.

The Ministry of Agriculture of Egypt evidently determined to test this new method of forecasting the cotton crop, and during the year 1915 arranged a number of stations in Egypt where the growth of various classes of the cotton plant could be observed systematically and complete data obtained of their rates of growth, flowering, and ripening of the bolls. The whole of the data thus collected has now been published in the *Agricultural Journal of Egypt* (vol. vii., 1917). An elaborate series of curves has been graphed from the data. It is apparent that one of the chief objects of the whole investigation was the testing of the new method of forecasting, for a statement is made to that effect. In spite of this, however, no direct reference is afterwards made in the report as to the effectiveness of the method, nor has an attempt been made to express an opinion.

The curves and data accompanying them have evidently been considered by the Egyptian authorities to be so adverse to this new method of forecasting that they have deliberately refrained from editorial comment.

Whilst this particular feature occupies nine-tenths of the report, it is evident from the other sections, in the form of editorial remarks and data, that previous to 1915 cotton-growing in Egypt was not conducted on correct lines, and that too strict an adherence to Mendelian principles was not yielding the results anticipated. In the editorial statements on this feature the phraseology used is unfortunately liable to misconstruction. It must, however, be conceded that further remarks on this feature make it clear that whilst Mendelian principles will be the basis of future work (this, of course, is inevitable), consideration will be given to practical factors according to districts and local conditions.

The whole subject is one of such practical utility that someone should be associated with the botanist to act as a guide in pointing out the direction in which utility is desirable. One or two details of the report—for instance, the measurement of the fibres, etc., and the import of them, the experimental spinning, and the interpretation of the results—clearly indicate the necessity for complementing the staff of the Egyptian Ministry of Agriculture dealing with cotton-growing by the addition of a man thoroughly acquainted with all the practical aspects of the cotton industry.

MODERN METHODS OF WELDING.

THE union of two pieces of metal by fire fusion and hammering is an old-established art in connection with iron, and is rendered easy by the fact that the change from liquid to solid is not abrupt in the case of this metal, which exists in a pasty condition over a considerable range of temperature. Since the invention of the oxy-hydrogen blowpipe by Hare in 1801, steady progress has been made with the welding of iron and other metals by methods involving flame heating, the earliest successes in this direction being achieved with platinum and lead. During the last ten years flame welding has made rapid strides, mainly owing to the use of acetylene as the combustible gas, and is now firmly established as an everyday process in all large engineering workshops. The high temperature procurable by the use of electricity has led to the development of electric welding, which is now employed for a large variety of operations, and may be expected to extend still more as electric power grows cheaper. In addition to the foregoing, a further method of welding is provided by the use of "thermit" mixture, which has proved successful for many classes of work. During the present time of stress all the methods named are being used to the utmost, and are playing an invaluable part in the production of munitions of war.

The gases used for flame welding may be either hydrogen, coal-gas, water-gas, or acetylene, which are burnt in blowpipes of suitable construction in air or oxygen, according to the temperature needed. Hydrogen is more expensive than the other gases named, and is used only in cases in which the work might be damaged by impurities such as sulphur and phosphorus, one or both of these being liable to be present in the alternative gases. Coal-gas has long been used for the autogenous soldering of lead, but has not been applied to any great extent to the welding of iron, owing to its varying composition and the presence of impurities. Water-gas, which has the advantage of being the cheapest of all gases suitable for welding, is now extensively employed for pipe welding, particularly in America and Germany, the parts to be joined being brought to a welding heat by blowpipes, and then hammered with a pneumatic hammer, or pressed together by rollers. Fig. 1, from a paper published by Capt. Caldwell, R.E., in the Transactions of the Institution of Engineers and Shipbuilders in Scotland for February last, shows a pipe welded in this manner and used in a hydro-electric installation in California. Water-gas is used in this connection as a substitute for a fire, and the temperature attained need not be so high as that required for fusion welding, in which joining is effected without hammering.

FIG. 1.—Large pipe welded by water-gas method. From Transactions of the Institution of Engineers and Shipbuilders in Scotland.

The oxy-acetylene flame is most generally used for fusion welding, owing to its high temperature, which, at the hottest part, approaches 3000° C., a further advantage being that a zone of unburnt hydrogen exists round the working-tip of the flame, which prevents oxidation of the work. In fastening two surfaces by fusion welding, the edges are chamfered and brought together so as to form a V-groove. The lowest part of the groove is brought to fusion by the blowpipe, and metal run in from a rod held in the flame, the process being continued until the groove is filled, when, if both the work and added metal have been thoroughly fused, a good joint will result. The oxy-acetylene flame is extensively used in this manner for welding iron, and is now growing in favour for joining non-ferrous metals, such as aluminium, copper, brass, and bronze. The framework of a Zeppelin is a notable example of fusion welding in aluminium, for which metal it is necessary to use a suitable flux. Largely owing to the work of Capt. D. Richardson, R.F.C., the welding of non-ferrous metals in this country has made great progress within recent years, the oxy-acetylene flame, and a flux suited to the metal under treatment, being generally used. The process is of special value in the case of aluminium, which cannot readily be joined by soldering.

Electric welding has long been employed for joining iron and steel rods, the ends to be pieced being brought together, and a strong current passed through the point of contact. This part, owing to its higher resistance, becomes hotter than the rest of the rod, and is allowed to reach the fusion point. Longitudinal pressure is then applied, so that complete union of the two parts may be ensured; and after releasing the pressure the weld is hammered during cooling. An alternating current is used, the requisite high current at low voltage being secured by the use of a transformer. This method is impracticable for sections above a certain diameter, owing to the excessive current that would be needed. A later development is what is known as "spot" welding, which is a substitute for riveting. In fastening together two overlapping plates by this process, the two electrodes are pressed, one above and one below, on the spot to be welded, and the current passed until a sufficiently high temperature is produced. The pressure is maintained during cooling, after which the work is brought forward and treated similarly at another spot. It is quite possible that spot welding may supersede riveting in shipbuilding, as the process can be applied to thick plates. An extension of the spot-welding process is to unite the plates along their whole length, by passing through rollers which form the electrodes, the rate of travel being such as to allow each part to attain a welding heat. So far, continuous seam welding of this kind has been applied only to comparatively thin sheets.

The foregoing electric methods are all based on the heating effect due to resistance. The high temperature produced by the electric arc is additionally utilised for welding, and has a varied and rapidly extending application. The carbon arc, which yields a temperature of 3700° C., is used for welding seams, the procedure being the same as when the oxy-acetylene flame is used as the source of heat. Direct current is used, the work being connected to the positive pole and the carbon to the negative. It is customary to work at a pressure of about 90 volts and a current of from 50 to 500 amperes, according to the size of the work. An adjustable resistance is used to regulate the current, and the carbon rod is held in an insulating holder, forming a handle by which the workman moves the arc along the joint. It is not attempted to bring the work to a higher temperature than is necessary for complete fusion, but this condition is brought about more rapidly by the carbon arc than by any other source of heat, and the method is much used in the production of seamless steel drums, etc.

A more recent development of arc welding consists in the substitution of an iron rod as negative electrode in place of the carbon, which is fused by the heat, and the fused metal carried across the arc on to the work opposite. The iron electrode, which is usually coated with a flux to prevent oxidation, is rapidly used up, and must be continuously moved forward by the welder to maintain the correct length of the arc. The deposited metal is hammered during cooling, and very satisfactory joints are thus secured. The best voltage to employ is as yet an unsettled question; in American practice 45 volts are commonly used, whilst in this country pressures ranging from 75 to 110 volts are general. Iron-electrode welding is particularly useful for repairing cracks in boiler-plates or shafts, the procedure in the latter case being to cut away the metal adjoining the crack on either side, forming two conical pieces meeting in a point. The part cut away is then filled in by the arc, commencing at the narrowest point and working outwards. Fig. 2 shows the method applied to the filling in of the worn parts of a tram-rail, a repair of this kind often saving the cost of a new rail. In all arc welding the eyes of the welder must be protected from the rays of the arc, and suitable glass screens are therefore provided. One advantage claimed for arc welding in the case of boiler repairs is that, owing to the heat produced being intensely local, a joint may be made without caus-

Fig. 2.—Repairing a tram-rail by arc welding, using an iron electrode.

ing strains in the vicinity, as may be produced by flame welding.

Thermit welding finds its chief application in work on large sections, such as rails and thick shafts. In welding together the ends of two consecutive rails, for example, the rails are made to touch, and a refractory mould is placed round the two ends. The thermit mixture, consisting of powdered aluminium and oxide of iron, is fired in a crucible by the ignition of a small quantity of a mixture of barium peroxide and aluminium, the reaction resulting in the production of aluminium oxide and metallic iron at a temperature of about 2500° C. The molten mass is run from the crucible into the mould, the quantity being such that the lower part of the rails is surrounded by molten iron and the upper part by the fused alumina. After a short time longitudinal pressure is applied to the rails, which are now at a welding heat, and complete union is secured. After removing the mould, the thermit iron is left adhering to the lower part of the joint and the slag broken away from the upper part. This is now the common method of welding rails, and forms a typical example of the use of thermit.

In comparing the various methods of welding, it may be said that each has its special advantages and is preferable for one kind of work. When a choice has to be made in a case in which the work could be executed by several methods, the user is guided by experience as to which is likely to suit best, and also by cost and convenience. In all instances much depends upon the skill of the welder, and figures showing the strength of welds will not be realised in practice unless the work is carried out by a thoroughly competent workman.

C. R. D.

SULPHURIC ACID AND THE WAR.

Modern warfare has been described as an affair of mechanics and chemistry. Of course, this is a very partial and incomplete definition, inasmuch as it neglects what, after all, is the paramount factor—the human element. But, given that the human factor is equally potent on both sides, it is certainly true that the belligerent which is most alert and most resourceful in the use of the methods and practical achievements of science will inevitably triumph in the end. The whole conduct of the war shows that our enemies have not been slow to appreciate this fact, and if we have been a little more tardy in learning the same lesson we are rapidly making good whatever leeway we may have lost.

Nothing distinguishes this war more markedly from previous campaigns than the manner in which the scientific knowledge and intelligence of the nation have been enlisted, both in its prosecution and in the repair of its ravages. We have a notable instance of this circumstance in the recently published Report of the Departmental Committee appointed to consider the post-war position of the sulphuric acid and fertiliser trades. Sulphuric acid is indispensable in war; a nation deprived of it, or of certain of the products which can be obtained only by its means, would be helpless in face of its enemies. It required, however, nearly nine months of actual warfare for those in authority in this country to realise the danger of a possible shortage in the supply of the sulphuric acid absolutely essential to the production of explosives, and a small but eminently competent committee of well-known manufacturers was at length appointed to advise the Government in the matter. The result was that the makers of sulphuric acid and its principal users were organised in view of the national emergency. The request that the demands of the explosive factories should receive priority was willingly acceded to, and it is satisfactory to learn that their requirements were fully met.

The enormous amount of sulphuric acid of high strength needed in the manufacture of explosives has, however, led to an extraordinary development in the industry, and to many far-reaching changes which those who are charged with the consideration of questions of what is termed "reconstruction" view with no little apprehension and concern. Concentrating plants on a large scale have been everywhere erected; large oleum plants have been constructed in connection with Government factories, and private manufacturers have been encouraged to extend their chamber plants and to work them continuously and intensively. The result is that the productive power of the country has now reached an amount greatly in excess of the pre-war consumption, and the problem which the Committee has had to consider is how this expansion can be dealt with in view of possible post-war requirements.

If the outcome of the war is to lead to the continued existence of militarism, the Government explosive factories with their contact and oleum plants will have to be maintained, for it is inconceivable that we shall revert to the fatuous policy of letting things take care of themselves, and of not foreseeing and making provision in advance, which prevailed at the outbreak of hostilities. As regards private manufactories of concentrated acid and oleum, it is to be expected that the resuscitation of the synthetic dye industry in this country will continue to absorb an increasing amount of these products. We may hope that it will prove to be one more instance of a superfluity in supply creating a new demand. But, however optimistic one may be in this respect, it can scarcely be doubted that for some time to come the supply will greatly exceed the demand, and that much plant will lie idle and may possibly be "scrapped."

There is at least one new source of sulphuric acid in this country, created by the war, which it is greatly to be hoped will be maintained and extended, and that is the production of acid from Australian zinc concentrates. The manufacture of zinc was instituted in this country before it was started in Belgium and Germany, but it has not been developed here to anything like its proper extent. Although London is the chief zinc market in Europe, the main production of the metal has been in the hands of Germans, who have also acquired a controlling interest in the Belgian concerns. This fact has, no doubt, something to do with the tenacity with which, under the pressure of Silesian magnates and capitalists, our enemy seeks to retain his hold on Belgium. It is well known that Germany, with the view of maintaining her practical monopoly in the production and distribution of zinc, gained control of the rich deposits of zinc ores in Australia, and that the great bulk of the Australian concentrates found their way to Belgium and Silesia, mainly by way of Antwerp and Hamburg, Germany's own deposits being meanwhile conserved. This is now, happily, a thing of the past, but whether the former condition is to be resumed time alone will show. Meanwhile, the consolidation and development of the zinc industry in this country are not proceeding at the rate which could be wished. The debate in the House of Commons on the Non-Ferrous Metals measure showed plainly enough that there are doctrinaires who are blind to our true economic interests.

There is one outlet for sulphuric acid which is capable of far greater development, and that is in the manufacture of fertilisers, and especially of superphosphates. There can be no doubt that the food shortage in the country, due to our enemy's activities, has had a profound effect on our agricultural policy, and will lead to a permanent increase in home production. This will, of course, necessitate a greatly increased demand for fertilisers, such as sulphate of ammonia, as well as of phosphatic manures. Much ammonia is at present absorbed in the production of nitrate of ammonia, which is needed in the manufacture of munitions. But this ammonia will be liberated after the war, and will be largely converted into sulphate for agricultural use. In the past about 60 per cent. of the sulphuric acid we produced was absorbed in the manufacture of fertilisers, in which there was a considerable, although of late declining, export trade, in addition to the home demands. The changed carrying conditions caused by the war may, if we seize our opportunity, lead to a recovery and possible extension of this export trade, induced, on one hand, by the comparative abundance of cheap sulphuric acid, and, on the other, by the greatly increased demand for fertilisers.

These and many other points are concisely dealt with in the admirable Report of the Committee now before us. It is an eminently businesslike production, commendably short and to the point. It has the merit, too, of being unanimous, and its recommendations are practicable and such as will appeal to practical men. They involve recommendations for (1) providing an outlet for, and generally dealing with, the surplus sulphuric acid which may be expected over pre-war production; (2) for the relief of acid and fertiliser makers from the competitive effect of surplus acid; (3) for improving the status of the technical chemist, for a more systematic study of manufacturing costs, and for the establishment of a strong national association of sulphuric-acid makers. All these are matters which directly affect the interests of the industries dealt with in the Report, and should, and no doubt will, receive the serious consideration of those immediately concerned. Legislation will presumably be required to give effect to certain of the proposals, but there are others upon which immediate action might be taken under existing powers, and although the end of the war is not yet in sight, it is very desirable that no undue delay should occur with respect to them.

T. E. THORPE.

INTERNATIONAL SCIENTIFIC NOMENCLATURE.

IN the *Comptes rendus* of the Paris Academy of Sciences for February 11 there is a manifesto in the form of a memorandum entitled "Observations on Modern Scientific Language" by a number of French men of science, MM. Bigourdan, Blondel, Bouvier, Branly, Douvillé, Guignard, Haller, Haug, Henneguy, Lacroix, Lallemand, Laveran, Lecomte, Lecornu, Lemoine, Maquenne, Emile Picard, Roux, Schloessing, jun., and Tisserand. The writers of this note enter a protest against a tendency they have observed on the part of the younger generation of scientific workers both to neglect literary form in their publications and to introduce new and strange words which are often unnecessary or badly constructed.

It is suggested that youthful authors may perhaps think that the use of outlandish expressions lends an air of learning to their communications, whereas the impression sometimes produced upon the reader is that he has come upon a bad translation of a work originally published in some foreign language.

It is pointed out that, owing to the international character of science, words and expressions which are quite appropriate in one language have been transferred bodily into another language without proper steps having been taken to adapt them to their new home. For example, our words "control" and "to control" have been translated "contrôle" and "contrôler." But "contrôler" means "to register," and, therefore, ought not to be used in the sense of "to regulate" or "to exercise an influence over." The English expression "self-induction" sometimes appears in French papers on electricity in the shortened form of "le self." Even an Englishman would find it difficult to discover the meaning of such an expression, so that a Frenchman may be pardoned if he finds it barbarous.

The writers of the note express the hope that the more closely the bonds between the Allied nations are drawn, the more care may be taken in translating scientific terms and expressions. It is suggested that international congresses and all forms of international co-operation afford a means of "controlling" the international language of science.

Attention is directed to the adjectives "thermostable" and "thermolabile," in the first place because these words are partly Greek and partly Latin, and in the second on account of the signification given to them. A "thermostat" is an instrument for maintaining a constant temperature, so that "thermostable" should apply to a condition in which the temperature remains constant, such as that found when a piece of ice is floating on ice-cold water. Yet the adjective "thermostable" is used to mean "not affected by *change* of temperature." The writers prefer the term "acyclic" to "aliphatic." Indeed, "aliphatic" is an unwieldy adjective, suggesting the inquiry as to whether elephants are really fat.

We are further told that in the writings of biologists we may read that "un microbe *cultivé* sur pommes de terre," and that "un animal *reproduit* en captivité," meaning in the first case that the microbe "can be cultivated," and in the second that the animal "reproduces itself," or, rather, "produces its offspring," in captivity. We learn also that the Latin genitive *coli* may be found used as a substantive to represent *Bacterium coli* or *B. coli* in such expressions as "cette culture renferme du coli."

We fear that the writings of English men of science are not free from the careless use of expressions which the writers themselves would not have employed had their attention been directed to them. It is also to be noted that many of the terms we have taken from the German are, perhaps, too literally translated. Why should "Farbstoff" always be rendered "dyestuff" instead of using the shorter word "dye"? Apparently there is no word for "dye" in German, so that they are obliged in Germany to use the cumbrous expression "colour-stuff."

There is, we fear, little likelihood that scientific workers will ever agree upon questions of nomenclature. About thirty years ago the British Association appointed a "Committee on Chemical Nomenclature." So long as this committee confined its considerations to the origin and history of the various chemical terms, it carried on its labours in perfect harmony, but as soon as it tackled the problem of laying down rules to guide future writers in the forms of nomenclature they should use, it was found that agreement was no longer possible, so that further meetings of the committee were abandoned.

Although complete agreement in these matters is not to be expected, we feel that there is some reason for the criticisms expressed by the authors of the memorandum.

NOTES.

WE regret to notice the death of Emile Yung, professor of zoology in the University of Geneva. A typical and patriotic Swiss, Prof. Yung studied zoology under the famous Carl Vogt, and after a period of assistantship became his successor at Geneva some thirty years ago. For many years the treatise on "Practical Comparative Anatomy," by Vogt and Yung, was a familiar book in zoological laboratories. It contained minute descriptions of a long series of types, and was uncommonly well done. Prof. Yung was greatly interested in the influence of environmental conditions on the organism, and made numerous experiments bearing on this problem. Thus he was one of the early investigators of the determination of sex in tadpoles, and supported the conclusion that the proportions of the sexes could be greatly altered by changing the diet. The value of this result was lessened, however, by the fact that the sex of the larvæ that died in the course of the experiments was not recorded. In another investigation he showed that the growth of tadpoles was modifiable by alterations of diet; thus tadpoles fed on beef grew three times as fast as those fed on plants. The effect of diverse temperatures and illuminations was also tested; thus tadpoles reared under violet light were emphatically longer than those reared under white light, and very much longer than those reared under green light. Prof. Yung took a keen interest in the description of the fauna of Switzerland, and made many a study of the plankton of the Lake of Geneva and its seasonal variations. Many of his experimental investigations had a pleasant quality of freshness. Thus we may recall how he took a score of marked bees from a hive near the lake, put them in a box, and liberated them in the country six kilometres away. Seventeen returned, some in an hour. Next day the seventeen were taken on a boat to a distance of three kilometres on the lake. When liberated, they flew about aimlessly, and none returned. Throughout a vigorous life Emile Yung did much for science, and his genial personality will be long remembered.

THE *Revue Scientifique* announces that Dr. Armand Thevenin, of the Sorbonne, died on March 7, aged forty-eight. He had been experimenting for some time with poisonous gases for the use of the French Army, and in the course of this work contracted an illness which unfortunately proved fatal. Geologists and palæontologists will lament Dr. Thevenin's premature loss, for he was one of the most accomplished members of the French school, full of activity in important research. For many years he collaborated with the Geological Survey of France on the south-western margin of the central plateau, and did much valuable work in stratigraphy. He was, however, more especially interested in fossils, and both at the Paris Museum of Natural History and (after 1913) at the Sorbonne he was engaged in many researches of which he published important results. His memoirs on the Permian reptiles and amphibians of France and on various fossils from Madagascar, contributed to the *Annales de Paléontologie*, will be specially remembered. Dr. Thevenin was president of the Geological Society of France in 1914, and received from the Academy of Sciences "le grand prix des sciences physiques" in 1909.

THE death is announced of Dr. Friedrich August Rothpletz, professor of geology and palæontology in the University of Munich. Born at Neustadt-a.-d.-Haardt, Bavarian Palatinate, on April 25, 1853, he graduated at Leipzig in 1882, and was engaged for some time on the Geological Survey of Saxony. In 1884 he became privat-dozent at Munich, in 1895 he was made extraordinary professor, and in 1904 he succeeded Prof. K. A. von Zittel as professor. Prof. Rothpletz had a very wide interest in geology, and wrote much on subjects so far apart as the structure of calcareous algæ and the folding of the rocks in mountain ranges. He was, however, always particularly fascinated by the geological problems presented by the Alps, and to these he devoted two important volumes, "Geotektonische Probleme" in 1894, and "Geologische Alpenforschungen" in 1900–8. He also studied the marine geological formations of the Canary Islands, and co-operated with Dr. Simonelli in a memoir on this subject, published by the Geological Survey of Spain in 1898. Prof. Rothpletz was well known to the geologists of this country, and was elected foreign correspondent of the Geological Society of London in 1894, and foreign member in 1905.

After thirty-eight years' service, Mr. Richard Hall has retired from the staff of the geological department of the British Museum. Entering the museum as an ordinary mason, he soon acquired remarkable skill in preparing fossil skeletons, and so did much to facilitate the progress of vertebrate palæontology. His extrication of the bones of Pariasaurus and Cynognathus from an almost intractable matrix began a new era in the study of South African fossil reptiles, which had previously been only imperfectly prepared; and *Dicynodon halli* is named to commemorate his success in this work. He also prepared the fine skeleton of Hyperodapedon from Elgin, described by Prof. Huxley in 1887, besides many other fossils now exhibited in the public galleries of the museum.

The seventy-first annual meeting of the Palæontographical Society was held at Burlington House on April 5, Dr. Henry Woodward, president, in the chair. Besides instalments of the monographs of Pliocene Mollusca, Cambrian Trilobites, Palæozoic Asterozoa, and Wealden and Purbeck Fishes, the first part of a new monograph of British Bellerophontacea, by Dr. F. R. C. Reed, was announced for publication. Mr. C. H. Cunnington, Mr. E. Gibson, Mr. A. W. Oke, and Dr. A. Strahan were elected new members of council; Dr. Strahan was elected new vice-president; and Dr. Henry Woodward, Mr. Robert S. Herries, and Dr. A. Smith Woodward were re-elected president, treasurer, and secretary respectively. In a brief address the president paid a tribute to the memory of Dr. G. J. Hinde, who for many years took an active part in the work of the society.

The council of Girton College recently decided to endeavour to raise a sum of money with which to found a fellowship for the encouragement of research in natural science, and especially in botany, as a memorial of Miss Ethel Sargant, whose original contributions to botany gained for her a prominent and honourable position in the scientific world. Miss Sargant was not only an original investigator of great ability, but she also consistently advocated the importance of providing opportunities of research for others. She was the first woman to preside over a section of the British Association and to serve on the council of the Linnean Society. Subscriptions may be sent to Miss E. Lawder (hon. treasurer of the Executive Committee of the Ethel Sargant Memorial Fund, Girton College), 25 Halifax Road, Cambridge.

The death is announced of Prof. Christian Hornung, at the age of seventy-three. For fifty years Prof. Hornung held the chair of mathematics and astronomy in Heidelberg University, Tiffin, Ohio.

Prof. J. H. Jeans and Sir William S. McCormick have been elected members of the Athenæum Club under the provisions of the rule of the club which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

The *Times* of April 9 announces the sudden death, in his sixty-first year, of Pandit Sir Sundar Lal, Vice-Chancellor of the University of Allahabad, and representative of the University on the Provincial Legislature. The successful organisation of the Benares Hindu University was largely due to his efforts, and he was its first Vice-Chancellor.

At the ordinary scientific meeting of the Chemical Society, to be held at Burlington House on April 18, at 8 p.m., the first of the Hugo Müller lectures will be delivered by Sir Henry Miers, who has chosen as his subject "The Old and the New Mineralogy."

The *Bulletin des Usines de Guerre* for March 18 (quoted in *Le Génie Civil*) gives particulars of a motor-car propelled by hydrogen which is probably the first of its kind. Experiments made with the vehicle show: (1) that a car motor can be made to work perfectly well with a mixture of pure hydrogen and air; (2) that it is not necessary to modify the construction of the motor; and (3) that the motor can be worked with a simple type of carburettor.

It is announced in *Science* that Prof. J. M. Coulter, professor of botany in the University of Chicago, has been elected president of the Chicago Academy of Science. Prof. Coulter is this year president of the American Association for the Advancement of Science and of the American Association of University Professors. Our contemporary also states that Dr. G. T. Moore, director of the Missouri Botanical Garden, has been elected president of the Academy of Science of St. Louis, to succeed Dr. E. A. Engler, whose death we announced recently.

The Minister of Munitions, in agreement with the Secretary of State for the Colonies and the Petroleum Executive, has appointed a Committee to inquire into certain matters relating to the production of fuel oil from home sources. The terms of reference are:—"To consider the report which has been rendered by the Petroleum Research Department on the production of fuel oil from home sources, and to advise to what extent, and within what time, it should be possible under present conditions to carry out the proposals made in this report; and to consider the steps which have been taken by the Ministry of Munitions in this connection." The members of the Committee are:—Marquess of Crewe (chairman), Col. A. Stirling, Maj. G. Collins, Engineer Vice-Admiral G. G. Goodwin (Engineer-in-Chief of the Navy), Sir Richard Redmayne (representing the Controller of Coal Mines), Sir Lionel Phillips (representing the Ministry of Munitions); secretary, Mr. G. C. Smallwood (Ministry of Munitions).

With the view of endeavouring to meet the coal shortage which has arisen, due to the tonnage question, the Danes have commenced the exploitation of the lignite deposits of Iceland and the Färoe Islands, while recent announcements indicate that an attempt will be made to work the coal-beds of the island of Bornholm. These latter deposits have been worked before, but had to be abandoned owing to difficulties of exploitation and the low calorific value of the fuel. The geological conditions, etc., have been given in a description of the island by Grönwall and Milthers published by the Danish Geological Department. Nevertheless, it is stated (*La Nature*, March 30) that geologists and a capitalist have resolved to take in hand the further exploitation of these deposits. The newspapers announce that it is hoped to obtain a yield of 500,000 tons per annum before long.

In an article in the *Morning Post* of April 4 entitled "The Long-range Gun: Some Future Possibilities," it is stated that military opinion in Germany and Austria seems to be that the bombardment of Paris is an experiment to obtain data for a similar attack on London. It is pointed out that once the problem of projecting shells to a range of seventy or eighty miles has been solved, speedy developments are certain to follow, with the possible result that shells, more destructive than those now being fired into Paris, could be thrown from Ostend to London, a distance of some 130 miles. It is pointed out that if the experiments on long-range ballistics, which were initiated in this country in 1887, had not been curtailed owing to the stupidity of our officials and politicians, we should probably have been the first to produce such a long-range gun, and it is urged that we should set to work at once to produce a better weapon than the German gun.

The results of two expeditions equipped by Mr. I. Wanamaker—one to work in the south, the other in the north, of Alaska—are described in the *Museum Journal* (vol. viii., No. 2, June, 1917). Among the collections received are old works of art handed down for many generations in the Chilkat tribe. The northern expedition worked among the Eskimo on the shores of the Arctic Ocean, who have been seldom visited, and retain many of their characteristic institutions. This expedition will throw much light on the chain of pure Eskimo culture which reaches from Labrador on the Atlantic side of the continent across the shores of the Arctic Ocean and Bering Sea to the Northern Pacific.

Mr. B. C. Wallis has contributed to the *Geographical Review* (vol. iv., No. 6, December, 1917) a paper on "The Peoples of Hungary: their Work on the Land." The paper gives a good instance of geographical control upon the life of man. The Magyar is deep-rooted in the heart of Hungary, the central Alföld. The Slovaks show a definite tendency towards the development of an economic life which essentially differs from that of the other races, due in part to the mountains and plains of which their land is composed, and yet in sharp contrast with the life of the Rumanians in Transylvania, where the best farm work is usually done by Germans or Magyars. This Slovak development has occurred in the face of direct opposition from the Magyar official class. The work of the Slovaks is also of greater value than that of either Croat or Serb in the south-west.

Dr. A. J. Chalmers and Wäinö Pekkola have published in the *Annals of Trop. Med. and Parasitology* (vol. xi., No. 3, pp. 213–64, two plates) a memoir on *Chilomastix mesnili*, a flagellate protozoon common in the intestine of man. A detailed account is given of the history of our knowledge of this organism, and of the morphology, fission, cyst formation, and systematic position. The authors believe that an infection can persist for years, but that when the organism increases in numbers it becomes pathogenic and causes diarrhœa. After a consideration of the known species of Chilomastix with the view of finding whether any animal is a carrier, the authors conclude that man is the important carrier of *C. mesnili*, and that the infection spreads from man to man by means of the cysts.

It is notorious that much more study has been devoted to the form than to the function of teeth. A recent paper entitled "Form and Function of Teeth: A Theory of Maximum Shear" (*Journ. of Anat.*, October, 1917), by Mr. D. Macintosh Shaw, of the Royal Dental Hospital, is particularly welcome, because it deals with the functional significance of dental cusps. Mr. Shaw has applied to the mechanism of mastication the "immense body of knowledge built up by engineers and mathematicians," and finds that the teeth are so shaped, set, and moved as to produce a maximum shearing stress on the material placed between their opposed blades. That the front, or incisor, teeth can act as shearing blades has been long acknowledged, but the application of this doctrine to the molar, or cheek, teeth is new. Mr. Shaw regards the outer, or buccal, cusps as shearing blades; the function of the inner, or lingual, cusps is quite different: they serve to retain the food in position so that it may be subjected to the shearing force applied through the outer cusps. He also points out how necessary canine teeth are to serve as guiding structures; canine teeth, by their sliding contact, ensure the alignment of the opposing shearing edges of the molar and premolar teeth. The crowns of the teeth are shaped so as to protect the gums from the impact of food during mastication.

During the past winter several distinguished medical men have been invited to Edinburgh to discuss the best means of improving the teaching of medical subjects. It was a fortunate choice that led to the invitation of Prof. Elliot Smith, of Manchester, to discuss "The Teaching of Anatomy." His lecture may be read in full (*Edinburgh Medical Journal*, March); here we need only summarise his chief conclusions. In his opinion "anatomy should be regarded as an integral and intimately co-ordinated part of the whole medical course, and it should be the business of the teacher to give expression to this broad view in his teaching." The anatomy taught must refer to the *living*, not to the *dead*, body. Dissection is essential for the proper training of the medical student. "The primary value of dissection to the student is to enable him to find his way about the body. Much of the knowledge he acquired is of a subconscious nature, but is none the less real on that account. By a limited experience I have learned to find my way from Princes Street to the University, but I cannot name a single street or landmark, nor give more than the vaguest description of the route, yet I have the essential knowledge which meets my needs. The vital knowledge of anatomy is of a similar nature." Prof. Elliot Smith regards the delivery of a systematic course of lectures on anatomy as indefensible, and the teaching of osteology as a separate subject as a "wicked and sterilising farce." The ideal course of instruction which he maps out aims at making anatomy the real basis of medical education.

The Mediterranean fruit-fly (*Ceratitis capitata*, Wied.), which has been introduced from Australia into Hawaii, where it has caused "a serious and permanent check upon horticultural pursuits," is described at length by E. A. Back and C. E. Pemberton in a recent Bulletin (No. 536) of the U.S. Department of Agriculture. The relation of the fly to various tropical fruits is discussed in detail.

British students of forest entomology may welcome the recent publication of two papers—one, by J. W. Munro, on Hylastes, a rather neglected genus of bark-beetles (Proc. R. Phys. Soc. Edinb., vol. xx., part 3, 1917), and the other on the Chermes of spruce and larch, by H. M. Steven (Proc. R. Soc. Edinb., vol. xxxvii., part 3, 1917). The latter will be especially useful as a guide to much recent Continental literature on a group with many bionomic problems.

Prof. D'Arcy Thompson, in the *Scottish Naturalist* for March, continues his analysis of the scarcer fishes of the Aberdeen market. In this article he passes in review the occurrences of the sturgeon, sea-bream, deal-fish, and red-mullet. The sturgeon, he shows, is most abundant off our coasts in the spring and early summer, when it is proceeding towards, or preparing to ascend, the rivers to spawn. The English records, he remarks, show a tendency to cluster round about the river mouths. "The Severn is a well-known haunt of this fish, and it would in all probability breed there if protected. All our records for that river are for April and May." Having regard to the importance of the sturgeon as a "food-fish," it would seem well worth while to afford the protection suggested by Prof. D'Arcy Thompson in this brief but valuable survey.

A VERY welcome insight into the life-history of the little penguin (*Eudyptula minor*) is afforded us by Dr. Brooke Nicholls in the *Emu*—the official organ of the Royal Australasian Ornithologists' Union—for January. Dr. Nicholls's shrewd observations have added much to our knowledge of the habits of these nocturnal birds. He has also told us much in regard to their food, moulting, the coloration of the soft parts, and the differences between the sexes, which are closely alike. His observations were made on Philip Island and neighbouring stacks. He comes to the conclusion, in spite of statements to the contrary, that there is but one species of little penguin on Philip Island, and expresses regret that these birds are "not found upon the list of our protected birds." The need for this step, he points out, is urgent, since they are now threatened by increasing settlement, and, besides, are largely used as bait by fishermen for their lobster-pots.

THE special Committee appointed by the Board of Agriculture, Trinidad, to inquire into the present position and prospects of rubber cultivation in the island has recently published its report in the Bulletin of the Department of Agriculture, vol. xvi., part 3. The report is a very interesting and valuable document, tracing the history of the industry from the year 1876, when two plants of *Hevea brasiliensis*, the Para rubber, were sent from Kew to Trinidad. The report is based on returns sent in from estates, but as several replies have not yet been received the total acreage under rubber cannot be given. From the returns received there are found to be 130,593 trees of Hevea, 81,975 of Castilloa, and 45,000 of Funtumia. The return for Castilloa should be much higher, as owing to the highly favourable views entertained as to this plant it was very largely planted in the colony. Experience has shown, however, that this Central American rubber tree is far inferior in every way to Para rubber as a plantation tree, and much of the work done in Trinidad must be regarded as a failure. On many estates Castilloa has now been removed, and a good deal of rubber land is derelict. The Committee points out that there is a good deal of land in Trinidad suitable for Hevea cultivation, and the report indicates clearly the proper lines on which planting should be undertaken and the returns which may be anticipated. The report ends with a summary of recommendations, in which the Committee states that, while cacao, sugar, and coconuts hold first place, Hevea should certainly rank in the front line of the secondary industries, such as limes, rice, and coffee. It is also pointed out that coffee may be interplanted with Hevea. Two important recommendations relate to the need for co-operation among rubber growers, and the formation of a Rubber Planters' Association, either on lines similar to those of, or in amalgamation with, the present Cocoa Planters' Association.

THE Advisory Council of Science and Industry of the Commonwealth of Australia has recently issued a bulletin upon "The Factors Influencing Gold Deposition in the Bendigo Goldfield." This goldfield is famous for the very exceptional character of its reefs of auriferous quartz, which are either bedded reefs, subdivided into saddle reefs, trough reefs, and leg reefs, or fault reefs or spurs. A large number of data concerning these reefs has been collected, but the inferences that can be drawn from these have not, so far, proved very helpful to the prospector. It is pointed out that the various dykes are geologically younger than the quartz reefs, and can have played no part in their origin, which is probably to be referred to the intrusion of the granodiorite in Lower Devonian times. Mineral solutions connected with this intrusion have been injected under pressure and have produced the reefs, in the case of saddle reefs mainly by the filling of fissures, in the case of the other types of deposit, mainly by replacement. The gold in the reefs is principally concentrated on the walls, and its distribution is never uniform along the reefs. Whilst "the replacement origin of the reefs provides a possible explanation for the gold shoots," it has to be admitted that "some additional factors, at present unknown or only guessed at, must influence the localisation of the shoots"; in other words, science has not yet progressed far beyond the old Cornishman's "Where she be, there she be"!

A NOVEL method of investigating the variation of the germicidal action of ultra-violet light with wave-length has recently been described in the Proceedings of the Royal Society, series B, vol. xc., by Drs. C. H. Browning and S. Russ. The method consists in photographing the ultra-violet spectrum on plates covered with a film of gelatine or agar-agar inoculated with micro-organisms instead of on an ordinary photographic plate. After suitable exposure these plates are incubated, and the action of the radiation is thereby rendered visible; those parts affected by the radiation remain transparent, while the remaining parts become opaque owing to the copious growth of the organisms which were not destroyed by the action of the rays. The region of activity of the radiation is between the wave-lengths 2960 and 2100 Å.U., with a maximum in the region 2800 to 2540 Å.U.; the rays are, however, easily absorbed by 0·1 mm. of skin, so that this type of radiation can only be effectual in dealing with organisms on the surface of a wound. The range of susceptibility varies slightly for different organisms, but not sufficiently so to provide a means of differentiating between several kinds.

AN account of the optical stores captured from the enemy, which were exhibited and described to the Optical Society in November by Lt.-Col. A. C. Williams, is given in the November issue of the Transactions of the society. The collection is fairly representative, and includes range-finders, directors for field and heavy artillery, dual sights, clinometers, sighting arcs, stereoscopic telescopes, periscopes, and sighting telescopes for machine-guns. Col. Williams pointed out how they all showed evidence of careful design and high-class workmanship, how lacquer had been discarded in favour of a tough, well-stoved enamel, and how in many cases the instruments had been painted after completion in order to cover all screws and render the instruments waterproof. Single complex prisms have been substituted for double reflecting prisms in order to diminish the loss of light and to facilitate adjustment. The balsaming of prisms together was well done, and the balsam very hard. From the discussion which followed the exhibition it appeared that while there was no new principle involved in the instruments captured, the working out of the details showed evidence of great care, and would repay study on the part of British instrument-makers. The instruments may be examined by permission of Prof. F. J. Cheshire, Imperial College of Science, South Kensington.

A LONG paper by Prof. Palazzo, chief of the Italian Meteorological Service, discussing magnetic observations taken at Theodosia, in the Crimea, between August 17 and 28, 1914, appears in the *Memorie della Società degli Spettroscopisti Italiani* (vol. vi., 1917).

The object of the observations was to obtain data for August 21, the date of a solar eclipse, which was total at Theodosia, and for comparison data from some adjacent days. The records were derived with the aid of a magnetograph of the Mascart type, which is fully described and illustrated by photographs. The curves were read at five-minute intervals for some hours during the time of the eclipse, and the tabulated results for declination, horizontal force, and vertical force are compared with the corresponding mean results from the adjacent days. The data are exhibited graphically in curves, with corresponding data from De Bilt (Netherlands), Rude Skov (Denmark), Seddin (Germany), and Ekaterinburg (Russia). In the case of horizontal and vertical force, it is shown that some movements, which might not unnaturally be associated with the eclipse if the Central European records only had been available, must be assigned to some other cause, but Prof. Palazzo is disposed to associate some of the declination phenomena with the eclipse. There are a good many references to earlier work on the subject.

Prof. A. Righi has published a second memoir (*R. Accademia delle Scienze dell' Instituto di Bologna*, November 25, 1917) dealing with the ionisation produced by X-rays in a magnetic field. In the first part of the paper Prof. Righi discusses the question raised in these columns (Nature, vol. c., p. 32, p. 224, 1917) of the possibility of explaining the experimental results as to the increase of current by taking into account the oblique, and therefore longer, paths of the ions under the joint actions of the two fields. He points out that the kinetic energy of an electron (or of an ion) depends only on the electric field and on the projection of the path on the direction of the said field, and is not affected by the existence of the magnetic field. Prof. Righi's own view of magneto-ionisation is that an electron in motion can ionise a gaseous atom by collision, when this is in a magnetic field, even if the kinetic energy of the electron does not reach that minimum which is necessary when the field does not exist. On this theory it is possible to explain not only the increase in current due to the magnetic field, but also the fact that when the field is made sufficiently strong there is an inversion of the observed effect, the current diminishing instead of increasing. There are two causes at work, producing opposite effects: magneto-ionisation and the magnetic deviation or change in the paths of the particles. The former increases with the magnetic field, but reaches a limiting value; the latter increases indefinitely, and finally gets the upper hand. The paper contains an analytical discussion of the motion of an electron in a uniform electric field on which is superposed a perpendicular magnetic field, a problem previously considered by Sir J. J. Thomson ("Conduction of Electricity through Gases") and treated elegantly by a purely geometrical method by W. B. Morton (Phys. Soc. Proc., vol. xxi., p. 300, 1909). The last part of the paper gives an interesting account of new experiments carried out with an apparatus specially designed to test the existence of magneto-ionisation. Curves are given showing the relation between the current and the applied potential difference for various magnetic fields. These indicate an increase in the current when a magnetic field is applied, the increase being most marked when the potential difference exceeds a certain value depending on the strength of the magnetic field.

The so-called "iminohydrins," or *iso*amides, were first prepared by Eschweiler in 1897, who gave them the general formula R.C(OH) : NH. They were afterwards (1901) investigated by Hantzsch, and given the dimolecular formula NH : CR.O.NH_2 : CR.OH. Dr. H. G. Rule has studied these compounds afresh, and gives an account of his results in the January issue of the Journal of the Chemical Society. He shows that they are amidine salts of the general type R.C(NH_2) : NH,R.CO_2H, and that "glycolliminohydrin," the first of Eschweiler's preparations, is really glycollamidine glycollate,

$$\mathrm{OH.CH_2.C(NH_2):NH,OH.CH_2.CO_2H.}$$

The constitution of this and similar compounds is proved by its synthesis by the interaction of sodium glycollate and glycollamidine hydrochloride, this method of preparation giving a far better yield than Eschweiler's method of treating the imino-ether hydrochlorides with moist silver oxide. Besides the glycol compound methoxyacetamidine methoxyacetate, acetamidine acetate and phenylacetamidine phenylacetate were prepared, whilst mandelamidine mandelate was obtained by Dr. J. E. Mackenzie. Molecular weight determinations, by the cryoscopic method, of these compounds support the new theory of their constitution, on the assumption that they are almost completely ionised in solution. To explain the formation of these amidine salts by the action of water on the imino-ethers, Dr. Rule suggests that the latter first undergo autohydrolysis, forming ammonium salts of the corresponding acids, and that these then interact with the imino-ethers.

In a paper on the possibilities of the ferro-concrete ship read by Major Maurice Denny at the Institution of Naval Architects on March 22, the author raises the interesting point of the permissible stress on the steel reinforcement under tension, without the risk of rupture occurring in the adjacent concrete. A usual figure taken in land structures is 16,000 lb. per sq. in. for the working tensile stress in the steel; with a modular ratio of 12·5 this would produce a tensile stress of about 1300 lb. per sq. in. in the neighbouring concrete—*i.e.* a stress sufficient to produce rupture of some sort. The matter is of serious importance in ship construction, owing to the necessity for maintaining watertightness. In the discussion on this paper—reported in *Engineering* for April 5—Mr. J. Foster King provided a long and valuable contribution, in the course of which reference was made to the same matter. Taking the elastic modulus of reinforced concrete to be the same as that of plain concrete —8 per cent. of that of steel—the permissible stress on the steel must not exceed 5400 lb. per sq. in. if the concrete is to remain unbroken. As reinforced concrete lost homogeneity under tensile stresses which exceed the breaking stress of the concrete by 45 per cent., the designed working stress on the concrete should be less than its own tensile strength, so as to leave such a margin between ordinary and extraordinary stresses as experience had forced upon shipbuilders. Experience of reinforced concrete had been derived from ratios of steel to concrete of about 1 per cent., and it seemed unreasonable to expect effective bond of steel and concrete when the ratio exceeds 8 per cent. Mr. King suggests experiments upon material exposed concurrently to tension and water pressure, in order to ascertain the point where steel and concrete cease to lend their properties to one another.

Erratum.—A correspondent points out that it was Pope Innocent VIII. who, in 1484, gave the sanction of the Church to the popular beliefs concerning witches referred to in Nature of April 4 (p. 82), and not Pope Innocent VII., as there stated. The reference in Dr. Withington's article was correct, but was wrongly given by the reviewer.

OUR ASTRONOMICAL COLUMN.

SPECTRUM AND RADIAL VELOCITY OF N.G.C. 1068.—Further photographic observations of the spectrum of the spiral nebula N.G.C. 1068 (M77) have been made at Flagstaff by Dr. V. M. Slipher (Lowell Observatory Bulletin, No. 80). Among the photographs obtained was one taken with a two-prism spectrograph, which received a total exposure of thirty-five hours during five nights. Besides confirming the composite character of the spectrum and the high velocity previously recorded, this photograph shows that the bright hydrogen lines extend farther into the fainter parts of the nebula than do the two green nebular lines, and that both bright and dark lines are strongly inclined. The inclination is about 5°, and indicates a rotation about an axis through the shorter diameter of the nebula, the velocity of rotation being approximately 300 km. per sec. at 1′ from the nucleus. This is the highest rotational speed which has yet been recorded, and there is evidence that the inner part is turning into the arms of the spiral, like a winding spring, as in the case of other spirals in which rotation has been observed. A peculiar feature of the emission lines is that instead of appearing as simple images of the slit, they appear as small discs; pressure increasing towards the nucleus is a possible explanation. The recent photographs consistently indicate the enormous receding velocity of 1120 km. per sec. for this nebula.

CHANGES IN THE SPECTRUM OF γ ARGÛS.—A preliminary account of some photographs of the spectrum of γ Argûs, which were taken at Cordoba with a 5-in. objective prism attached to the astrographic equatorial, has been given by Dr. C. D. Perrine (*Astrophysical Journal*, vol. xlvii., p. 52). The star is well known as being the brightest example of the Wolf-Rayet type, and the new observations appear to show comparatively rapid fluctuations in the structure of H_β, which is doubly reversed. While the bright band was most intense on the red side of the weak absorption line on plates taken in August, 1917, it was brightest on the violet border during November. Variations in the widths of the bright bands in the region λ 450 are also indicated. From a comparison with earlier records by other observers, it is concluded that considerable changes have occurred during the last twenty years. Dr. Perrine has further noted a broad, faint brightening in the region of the chief nebular line, and a suspected brightening in the region of the second nebular line; it may be suggested, however, that these are not the nebular lines at all, but the adjacent lines of helium, as previously photographed at Johannesburg by W. M. Worssell. The latter photographs, it may be recalled, gave no certain evidence of secular changes in the spectrum.

UNITED STATES NAVAL OBSERVATORY.—The report of the U.S. Naval Observatory for the year ending June 30, 1917, has been received. The routine observations were continued without intermission, including meridian work, observations of comets and occultations with the equatorials, observations of asteroids of special interest, and photographic investigations of the variation of latitude. The nautical instrument repair shop was especially active, and has continued to prove economical both in time and expense; more than 3000 instruments were put in order during the year. The observatory has continued to encourage suggestions and developments of methods and instruments for navigation, particularly for submarines and aircraft.

CORRECTIONS TO THE BONN DURCHMUSTERUNG.—Prof. F. Küstner, director of the Bonn Observatory, publishes in *Astronomische Nachrichten*, 4929, a useful list of corrections to the B.D., which all astronomers who use that work would do well to incorporate in their copies; some of the corrections refer to the star-positions, others to their magnitudes, others to the catalogue references, whilst a list is given of the stars in each volume that have been recognised as variables since the publication of the B.D. Considering the immense number of stars in the catalogue, and the small size of the instrument with which it was made, the list of errata is extremely short, and reflects the greatest credit on Argelander and his assistants.

AURORAL OBSERVATIONS IN THE ANTARCTIC.

THE paper referred to below[1] was prepared, the author tells us, in 1911, but printing was delayed as Sir E. Shackleton, the leader of the 1908 Antarctic Expedition, hoped to publish the scientific work as a complete series. That idea unfortunately had ultimately to be abandoned. The paper is a very valuable contribution to our knowledge of aurora, and its appearance, if late, is very welcome. The auroral log occupies pp. 155–200, and includes particulars of the times when aurora was observed, and various descriptive information as to the nature and trend of the aurora when it consisted of curtains, arcs, or streamers having a definite direction. A preface explains the scheme of observations, and the terms employed are dealt with in the introductory remarks. Sir Douglas considers the curtain the fundamental type of aurora. When streamers alone are visible, they represent in general, he thinks, "the visible parts of an invisible curtain."

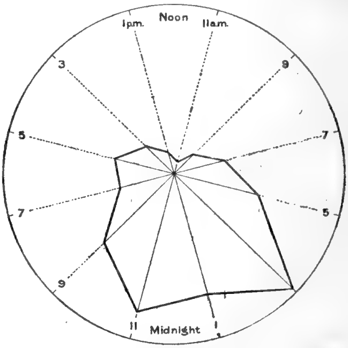


FIG. 1.—Daily time-distribution at Cape Royds. Graphical illustration of the relative frequency of auroral phenomena at different hours of the day. Radius vectors on scale such that 3/160th in. equals one hour's display.

A discussion of the phenomena is given in a summary, pp. 201–12. This is illustrated by a plate and by Figs. 1 and 2, here reproduced. Fig. 1 shows the diurnal variation in the frequency, and Fig. 2 the relative frequency with which aurora was observed in the different geographical directions. Only the observations of June, July, and August, 1908, were employed. The station being at 77° 32′ S. lat., the sun was continuously below the horizon during these months, so the disturbing effects of daylight or twilight were at a minimum. Observers in the northern hemisphere have usually, if not always, found the maximum frequency before midnight. At Cape Royds, as Fig. 1 shows, it appears near 3 a.m. This is in general agreement with the conclusions reached by Mr. L. C.

[1] "Auroral Observations at the Cape Royds Station, Antarctica. British Antarctic Expedition, 1908." By Sir Douglas Mawson. (From Trans. Roy. Soc. of S. Australia, vol. xl., 1916, pp. 151–212.)

Bernacchi, the physicist of the first Scott Antarctic Expedition, 1902–4. The result is of obvious importance in any theoretical explanation of aurora. The plate, which is not reproduced here, deals with the diurnal variation of the frequency of aurora as seen in different geographical directions. A maximum of frequency near 3 a.m. was observed in most directions, from N. through E. to S.E., but not in all directions, *e.g.* west.

Fig. 2 shows in the clearest way that aurora at Cape Royds was much more in evidence to the east than to the west. The magnetic needle at Cape Royds pointed about 30° east of south, *i.e.* the S. magnetic pole of the earth lay north of N.W. Sir Douglas seems to think that the greater frequency in the east may be due to that being the direction of the open sea, land areas prevailing to the west. It may mean, however, only that Cape Royds lies within the zone of maximum auroral frequency.

Some of the author's conclusions are very suggestive. "Making due allowance," he says (p. 206), "for the obscuring effect of daylight . . . auroral phenomena . . . at Cape Royds favour the portions of the sky which are (*a*) directed towards, (*b*) directed away from, the sun, having regard for the position of the

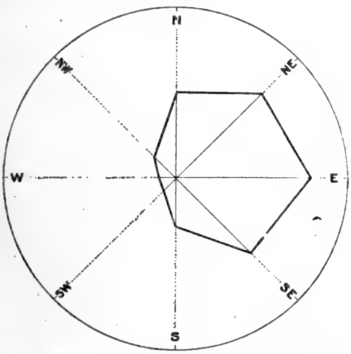


FIG. 2.—Distribution in azimuth of auroral phenomena at Cape Royds. Graphical illustration of the relative frequency of aurora seen at Cape Royds in relation to geographical direction. Radius vectors on scale such that 1/8th in. equals one hour's display.

latter at the time of observation." Again, p. 207: "Auroral displays at Cape Royds are distinguished by the large proportion of curtains traversing the heavens in a linear, or nearly linear, direction. A remarkable daily sequence was observed in their trends. Always (on the average) they appeared directed approximately towards the sun. Thus, should a curtain persist for any length of time, it was noted always to exhibit a slow rotational movement counter-clockwise." On p. 209 we read: "After due consideration the following interpretation has been adopted: that at Cape Royds, in the case of steady, straight bands and curtains, they take up a position . . . approximately directed towards the sun." In June and July aurora was visible every day when clouds permitted, but the majority of the displays in these months "were much calmer and [more] localised than during the preceding or succeeding months."

In the daily logs there are frequent indications of the observer's impression that the aurora was at no very great height, and that its form was influenced by Mt. Erebus when it lay in that direction. Thus, of an aurora on May 23 it is said:—"As it extended past the cone of Mt. Erebus, there appeared a local bend, curving outwards from the mountain . . . the lower border appeared to show below the summit of the mountain." Of a curtain on May 31 it is said:—"It appeared to be very low over Mt. Erebus, and to touch the . . . crater. At one stage it ringed the crater." On June 21, we are told, "a strong luminous nebula appeared on the N. flanks of Mt. Erebus. . . . The luminous nebula stood out brightly between us and the slopes of Mt. Erebus."

In view of the apparent conflict between these observations and the measurements of auroral heights made of late years by Prof. Störmer and others in the Arctic, it is obviously desirable that the programme of the next Antarctic expedition should include the measurement of auroral heights after Prof. Störmer's method. A 25-km. base, such as Prof. Störmer used in his latest observations, is, however, naturally fitted only for measuring great heights, so it would be well to have, in addition to a long base, a much shorter one of 2 or 3 km., the two bases having desirably one station in common. Sir Douglas tells us that the records of the Australasian Antarctic Expedition of 1912–13 supply much fuller information as to aurora than those of the 1908 expedition, so we may look forward to an even more valuable contribution from his pen on a future occasion.

C. CHREE.

THE ANNUAL CONFERENCE OF THE NATIONAL UNION OF TEACHERS.

THE conference of the National Union of Teachers, which was opened at Cambridge on Monday, April 1, gave a welcome opportunity for a declaration of policy on the part of this large and influential body on the question of the Education Bill now before Parliament. It is satisfactory to observe that the conference resisted all amendments to the Bill on the ground that it was desirable to present to the House of Commons a clear call in favour of the general principles embodied in the Bill, and to trust to the future for any desirable amendments in its provisions. It secures at least the abolition of half-time, mainly prevailing in the textile areas of Lancashire and Yorkshire, and of the labour certificate, which took the intelligent child from the schools at a premature age. It gives the further advantage of continued education, both general and special, within the working hours of young people from fourteen to eighteen years of age, by which means two and a half millions of adolescents will continue within the healthy influence of the school in preparation for life and in the right use of leisure, and so promote a higher standard of citizenship, and thus make fruitful the early training begun in the day schools.

In the course of her presidential address Miss Conway dwelt upon the extraordinary demand which would be made on the teaching profession, not only in meeting the requirements of the new Bill, but also in supplying the grievous loss entailed by the present and future exigencies of the war. Already some 20,000 teachers out of about 37,000 have been called up for service with the Army in the field, 1000 of whom have given their lives. Women, as in so many other spheres of labour, have been called upon to fill the places of men so withdrawn, but under onerous conditions of much larger classes in schools, often disorganised, and they have nobly and successfully responded. The adequate training of the teacher is admitted to be a matter of the most serious concern, but it cannot be expected that the profession will continue to attract gifted men and women to its service, especially that of women, upon whom the duty to a much larger extent in the future will inevitably fall, unless its status be raised, its prospects improved, its emoluments increased, and suitable retiring pensions provided. The advent of women in the political sphere will of necessity open up other professional careers for women, the training for which will not be more onerous than that of the teacher, and in which the prospects will be more attractive and the remuneration in proportion to the skill employed without reference to sex. Equal pay for equal service found eloquent expression at the conference, but on a division was defeated by 16,717 votes, whereupon a referendum will be taken. Despite Mr. Fisher's declaration of minimum salaries, which gave a proportion of nine-tenths to women as compared with men, the tendency to a much larger differentiation, especially in London, is on the increase, the maximum of the women head-teachers in many cases in that area being actually 20*l*. below the minimum of the men head-teachers.

The poor remuneration of teachers is strikingly shown by a return of the Board of Education of November last, where it appeared that out of 36,827 certificated men teachers, 2639 received less than 100*l*. per annum, and out of 77,139 certificated women teachers, 32,314 received less than the foregoing sum. Until this matter receives drastic reform it is impossible to ensure a contented and happy body of teachers.

The provision of nursery schools, where children can have the advantage of trained nurses and medical advice, and which should be linked up with the neighbouring elementary schools, was warmly commended as tending to ensure a much better supply of healthy children. A strong plea was put forward for the employment of capable cultured women in the active work of the contemplated continuation classes, so as to give to the girls a wise training in matters relating to their responsibilities as citizens and in the duties of domestic life, and no less was it urged that men of broad sympathy and of wide academic and professional training should be placed in charge of the boys. Teachers are anxiously awaiting the enactment of the Fisher Bill, which gives effect to many of their most ardent aspirations cherished during many years. The conference adopted a scheme for the direct representation of teachers on all education committees.

THE INDIGO INDUSTRY.

IN the *Agricultural Journal for India* (vol. xiii., part i., January, 1918) Mr. W. A. Davis, indigo research chemist to the Government of India, gives a review of the present position and future prospects of the natural indigo industry. In 1896, the year before the large-scale introduction of synthetic indigo, the combined exports of natural indigo from India and Java had a value of more than $3\frac{3}{4}$ millions sterling, whilst very large additional quantities were also produced and consumed in India, China, and Japan. The value of the total world's market for indigo under pre-war conditions considerably exceeded five millions sterling, a value almost equal to that of all other artificial organic dyes put together.

The rapid displacement of the natural by the synthetic product is evidenced by the facts that whilst the exports of synthetic indigo from the German Customs district rose from 658 tons in 1895 to 16,354 tons in 1907, the exports of natural indigo from India fell in the same period from 9367 tons to 1755 tons, with a further decline to 547 tons in 1913–14. Nearly the whole of the last-named export consisted of the higher-grade Bihar indigo, the export of the lower-grade Madras indigo having practically ceased. Again, whereas in 1897 the price of natural indigo of better quality (60–70 per cent.) was 7*s*.–8*s*. per lb., the price in 1914 before the war had fallen to 3*s*. per lb. The number of employees engaged in indigo manufacture in India fell from 360,000 in 1880 to 30,795 in 1911.

The first effect of the war was to cause an enormous increase in the price of natural indigo, and steps were immediately taken to increase the cultivation, with the result that in 1916–17 the total area under indigo in India was three and a half times the average of the preceding five years, although still less than one-half the area of 1895. The statistics of the exports of synthetic indigo in the years before the war reveal the fact that China and Japan together took three-fifths of the whole production. It is very clear from these data that the prosperity of the Indian industry and its ability to compete with the synthetic product in the future will depend largely upon its being able to supply these Eastern markets. Mr. Davis is hopeful that the Indian industry will be able at least to put up a good fight, and he proposes in a future article to outline the measures of improvement which must be effected if success is to be achieved.

A FRENCH SOCIETY OF CHEMICAL INDUSTRY.

THE issue of the *Revue Scientifique* for March 2–9 contains an interesting account of the aims and organisation of La Société de Chimie Industrielle, which has been established in France with the object of promoting and consolidating the development of the chemical industries of the country. The formation of a society similar in character to our own Society of Chemical Industry had been under consideration before the war; the circumstances of French chemical industries during the period of the war have now given the necessary stimulus for the realisation of the project, with the full co-operation and support of the leading chemists, chemical engineers, and manufacturers of the country. The outstanding objects of the new society are to aid the development of all branches of chemical industry, to co-ordinate the labours of all workers in pure and applied chemistry for their mutual advantage, and to assist the progress of industrial chemistry not only by means of science, but also from the economic and commercial points of view. These objects, which are planned so as not to interfere with or overlap the work or publications of existing societies, are to be developed by the publication of a *Review*, the first number of which has already been issued, by the holding of conferences, exhibitions, and competitions, and by the establishment of a bureau of industrial chemistry and of a central library. The president of the society is M. Paul Kestner; Profs. A. Haller and H. Le Chatelier are hon. presidents; MM. F. Binder, Duchemin, Matignon, and Staub vice-presidents; M. Jean Gerard general secretary; and Comte G. de Germiny treasurer.

The formation of this new society shows that in France, as in this country, the national importance of the services of chemical science needs far fuller recognition than in the past, especially in the direction of effecting that co-operation between science and industry which is fundamental for the economic development of scientific discoveries. La Société de Chimie Industrielle should do much to secure this co-operation, and we cordially wish its promoters every success in the wide and well-chosen field of their proposed activities.

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

THE Parliamentary Paper dealing with Class IV. of the Estimates for Civil Services for the year ending March 31, 1919, has now been issued. The subjoined summary gives the main items of the estimated expenditure for the year, with the details relating to scientific investigation and higher education. Reference may be made to a few particular points in these Estimates. A special grant of 30,000*l*. is included in aid of certain universities, colleges, medical schools, etc., to meet loss of income arising from circumstances of war. It may be remembered that the Estimates for 1915–16 included a similar grant of 145,000*l.* for the same purpose. The grant for the National Physical Laboratory has been transferred from the head of the Royal Society, under which it formerly appeared, to that of the Department of Scientific and Industrial Research. It amounts to 89,750*l.*, being an increase of 64,475*l.* upon the grant for 1917–18. The State receives, however, for testing fees and other services rendered by the laboratory the sum of 11,250*l.*, and 3000*l.* as contributions from co-operating bodies. The new Fuel Research Station has a grant of 7000*l.*, of which 4000*l.* is required for salaries and wages, and 3000*l.* for apparatus, materials, etc. The grants made by the Department of Scientific and Industrial Research amount to 56,500*l.*, in comparison with 30,000*l.* in 1917–18. The salaries, wages, and allowances of the Department are estimated at 8900*l.*; and we notice that this estimate includes 500*l.* as fees to expert consultants.

The estimated grants for technical schools, etc., are 634,500*l.*, being an increase of 103,000*l.* on those of 1917–18, made up chiefly of 5000*l.* to technical schools, 7000*l.* to junior technical schools, 40,000*l.* to other schools and classes, and 50,000*l.* in supplementary grants. The grants to university institutions in respect of technological work are increased from 60,000*l.* to 65,000*l.* Most of the other grants remain the same as last year; the total of the whole Estimates under Education, Science, and Art is 25,529,228*l.*, which is a decrease of 690,803*l.* on the Estimates for 1917–18.

United Kingdom and England.

BOARD OF EDUCATION.

	£
Administration	216,103
Inspection and examination	218,560
Grants in respect of public elementary schools, etc.	15,924,138
Grants for training of teachers	422,200
Grants towards expenditure on secondary schools and pupil teachers and bursars, etc.	1,568,570
Grants towards expenditure on other aided institutions, schools, and classes, and on assistance in choice of employment	724,035
Imperial College of Science and Technology and Chelsea Physic Garden (grants in aid)	32,150
Royal College of Art	7,512
The Victoria and Albert Museum	62,153
Science Museum	13,435
Geological Museum	3,336
Geological Survey of Great Britain	15,006
Bethnal Green Museum	2,382
Gross total	19,209,580
Deduct— Appropriations in aid[1]	2,875
Net total	19,206,705
Net increase[2]	190,925

[1] In addition, receipts from sale of catalogues and other publications supplied by the Stationery Office, estimated at 400*l.*, will be paid to the Vote for Stationery and Printing.

[2] Total original Net Estimates, 1917–18 ... £15,159,780
Add Supplementary Estimate ... 3,856,000
£19,015,780

BRITISH MUSEUM.

	£
British Museum[3]	90,022
Natural History Museum	44,045
Gross total	134,067
Deduct— Appropriations in aid	7,925
Net total	126,142
Net decrease	2,453

IMPERIAL WAR MUSEUM.

Salaries, expenses, purchases of exhibits, etc. (grant in aid)	19,000
Net decrease	2,000

SCIENTIFIC INVESTIGATION,[4] ETC.

	£
Royal Society	6,000
Meteorological Office	22,500
Royal Geographical Society	1,250
Marine Biological Association of the United Kingdom	500
Royal Society of Edinburgh	600
Scottish Meteorological Society	100
Royal Irish Academy	1,600
Royal Irish Academy of Music	300
Royal Zoological Society of Ireland	500
Royal Hibernian Academy	300
British School of Athens[5]	—
British School at Rome	500
Royal Scottish Geographical Society	200
National Library of Wales	3,200
National Museum of Wales	7,500
Solar Physics Observatory	3,000
School of Oriental Studies	4,000
North Sea Fisheries Investigation[5]	—
Royal College of Surgeons in Ireland	500
Edinburgh Observatory	1,691
Total	54,241
Net decrease	20,490

SCIENTIFIC AND INDUSTRIAL RESEARCH.

	£
Salaries, wages, and allowances	8,900
Travelling and incidental expenses	1,200
Grants for investigation and research[6]	56,500
Fuel Research Station	7,000
Scientific and industrial research (grant in aid)	—
National Physical Laboratory	89,750
Gross total	163,350
Deduct— Appropriations in aid	15,000
Net decrease	914,975

[3] The British Museum (Bloomsbury) (except the reading-room, etc.) and part of the Natural History Museum, South Kensington, are closed during the war.

[4] The expenditure out of these grants in aid, with the exception of that for the Meteorological Office, will not be accounted for to the Comptroller and Auditor-General, nor will any unexpended balances of the sums issued be surrendered by the payees at the close of the financial year. In the case of the Meteorological Office the expenditure, though not liable to surrender of balance, will be subject to audit by the Comptroller and Auditor-General.

[5] These grants are suspended owing to the war.

[6] These grants will be distributed by a Committee of the Privy Council, on the recommendation of an Advisory Council, to promote the development of scientific and industrial research in the United Kingdom, and will be subject to such conditions as the committee may think necessary.

Universities and Colleges.

Universities and Colleges, Great Britain.

	£
University of London	8,000
Victoria University of Manchester	2,000
University of Birmingham	2,000
University of Wales	4,000
University of Liverpool	2,000
Leeds University	2,000
Sheffield University	2,000
Bristol University	2,000
Durham University	2,000
Scottish Universities	84,000
Colleges, Great Britain	150,000
University Colleges, Wales	12,000
Welsh University and Colleges: Additional grant	20,500
Total for Universities and Colleges...	292,500

Intermediate Education, Wales.

	£
Examination and inspection, grant in aid...	1,200
Schools	28,000
Total for Intermediate Education, Wales	29,200
Grand total	321,700
Increase	500

Scotland.

Public Education.

	£
Administration	30,082
Inspection	43,357
Elementary schools	2,614,914
Continuation classes and secondary schools	214,500
Royal Scottish Museum, Edinburgh ...	9,876
Training of teachers	127,245
Examination of accounts	1,571
Total	3,041,545
Net decrease	2,076

Ireland.

Public Education.

	£
Administration	34,553
Inspection	51,713
Training colleges	67,967
Model schools	4,831
National schools	1,963,830
Manual and practical instruction	13,767
Teachers' residences	6,550
Superannuation, etc., of teachers (grants in aid)	60,593
Gross total	2,203,804
Deduct—	
Appropriations in aid	700
Net total	2,203,104
Net increase	1,086

Intermediate Education.

	£
Towards salaries of teachers, including cost of administration	40,000
Intermediate Education	50,000
Total	90,000

Science and Art.

	£
Institutions of science and art	48,612
Schools of science and art, etc.	114,050
Geological Survey	1,801
Examinations in courses of instruction conducted in technical schools	700
Gross total	165,163
Deduct—	
Appropriations in aid	1,770
Net total	163,393

Universities and Colleges.

	£
Grants—	
Queen's University of Belfast	18,000
University College, Dublin	32,000
University College, Cork	20,000
University College, Galway	12,000
National University of Ireland and University College, Dublin	12,350
Additional grant to University College, Galway	2,000
Total	96,350

Summary.

United Kingdom and England.

	£
Board of Education	19,206,705
British Museum	126,142
National Gallery	11,639
National Portrait Gallery	3,779
Wallace Collection	4,012
London Museum	2,300
Imperial War Museum	19,000
Scientific Investigation, etc.	54,241
Department of Scientific and Industrial Research	148,350
Universities and Colleges, Great Britain, and Intermediate Education, Wales ...	321,700
Universities, etc., Special Grants	30,000
Scotland.	
Public Education	3,041,545
National Galleries	4,283
Ireland.	
Public Education	2,203,104
Intermediate Education (Ireland)	90,000
Endowed Schools Commissioners	855
National Gallery	1,830
Science and Art	163,393
Universities and Colleges	96,350
Total	25,529,228
Net decrease	690,803

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is stated in *Science* that the Carnegie Corporation has presented McGill University with 200,000*l.* in recognition of the University's "devoted service and sacrifice towards Canada's part in the war."

The sum of 4000*l.* has been given by Mr. F. W. Chance to the Carlisle Education Committee for the establishment of a laboratory and lecture-room for chemistry and physics. An income of 600*l.* a year is assured for five years. The gift is intended as a memorial to the late Capt. A. F. Chance.

MR. GEORGE MATTHAI, of Emmanuel College, Cambridge, who for three years held the MacKinnon studentship (on the biological side) of the Royal Society, has been appointed by the Secretary of State for India to the Indian Educational Service as professor of zoology, Lahore, Punjab, India.

THE Markham Skerritt memorial prize of the University of Bristol is awarded to the medical member of the University of Bristol who has in the previous three years published the best original work in any branch of medical science. The consideration of this year's award will be given by the medical board of the University on May 3.

NOTICE is given of the impending award of the Lindley studentship in physiology of the University of London. The studentship is of the value of 100*l.*, and awarded every third year. Statements of the qualifications of intending candidates and particulars of their proposed modes of research must reach the academic registrar of the University by April 30. Applications for grants from the Dixon fund must be received not later than the first post on May 15.

AMONG the lectures arranged at University College, Gower Street, W.C.1, for the third term of the current session, and announced in the *London University Gazette,* are the following:—A course on "Some Biological Problems of To-day" includes lectures beginning at 5 p.m.: on May 13, by Dr. H. M. Vernon, on industrial efficiency and fatigue; on May 27, by Prof. F. W. Oliver, on substitution of raw materials; on June 3, by Dr. R. C. McLean, on the anaerobic treatment of wounds; and on June 10, by Prof. H. R. Kenwood, on fresh air and efficiency. On May 2, at 2.30 p.m., Prof. W. M. Flinders Petrie gives the first lecture of a course on the "Objects of Daily Life." The lectures are open to the public without fee.

THE new South African University of Cape Town was inaugurated on April 2. The Prince of Wales has accepted the Chancellorship, and sent an appropriate message wishing success to the new venture. As has been recorded in these columns already, three Acts were passed by the Union of South Africa in 1916 constituting and establishing three universities in the Union. The University of the Cape of Good Hope, together with certain institutions, was by one of these Acts incorporated in a federal University; a second Act provides that the Victoria College, Stellenbosch, in the Cape of Good Hope, shall be incorporated as a University; and a third Act similarly incorporates South African College, Cape Town, as a University. As a result of these Acts, the University of the Cape of Good Hope becomes the University of South Africa, with its administrative seat at Pretoria, and it has six constituent colleges. The Victoria College, Stellenbosch, becomes the University of Stellenbosch, with its seat in the division of Stellenbosch, in the province of the Cape of Good Hope. The South African College becomes the University of Cape Town, and its seat is to be upon the Groote Schuur estate in the Cape Division of the Cape of Good Hope. The *Times* correspondent at Cape Town states that at the inauguration of this University stimulating speeches were delivered by Lord Buxton, in his double capacity of Governor-General of the Union and visitor of the new University, Mr. Malan, Minister of Education, and the Principal, Prof. J. C. Beattie.

PROF. R. WALLACE, of the Department of Agriculture in the University of Edinburgh, has addressed a long open letter to the Prime Minister "urging *postponement* until after the war, as well as the effective *recasting,* of the English and Scottish *Education Bills*—legislation dangerous to the stability of the Empire and subversive of the soundest canons of education." It would have been a more gracious act had Prof. Wallace addressed himself to the respective heads of the Departments for Education of England and Scotland, and especially to Mr. Fisher, who has shown his complete familiarity with questions of education, and has been at such pains to make clear the principles upon which all sound education should be based and the means whereby they are to be realised. It would be well for Prof. Wallace to turn his attention to the preface written by Mr. Fisher by way of introduction to his educational reform speeches, wherein he says that "many people have a very limited faith in the value of education. They are prepared to believe that it is good for well-to-do people—for the aristocracy of the human race, upon whom the task of intellectual leadership is devolved. . . . They remember their own schooldays, and . . . reflect that schooling did not help them, so far as they can remember, to earn a single shilling, and so they think and talk against education, and, if they are very silly, write books against it." Prof. Wallace, with all his profession of intimate knowledge of the 85 per cent. of the population and its real needs, cannot ignore the unanimous resolve of the great body of the elementary-school teachers to give the fullest support to the Education Bill, since they are in the main drawn from the same class as their pupils, and must have actual experience of their needs. They are convinced that the true policy is "to put the *whole* child to school," and its solution is not to be found "in relays of children [who] should follow each other during the working hours of the day to maintain a continuous supply of labour," nor, if the child "is to be a competent attendant on either cattle or sheep," he "must grow up with them and begin to know and understand them before he is ten," as Prof. Wallace demands.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, March 20.—Mr. G. W. Lamplugh, president, in the chair.—Dr. W. F. **Smeeth**: The geology of Southern India, with particular reference to the Archæan rocks of the Mysore State. The geological formations of Southern India consist largely of a highly folded and foliated complex of Archæan gneisses and schists, followed by patches of pre-Cambrian slates, limestones, and quartzites; with these are associated basic lava-flows and ferruginous jaspers. The remaining formations consist of remnants of the Gondwana Beds (Coal Measures of Permo-Carboniferous age), a few patches of Cretaceous rocks, some Tertiary and Pleistocene deposits, and recent sands and alluvium, all situated along the coastal margins of the Peninsula. The scanty post-Archæan record of Southern India was contrasted with the formations of Northern India which record oft-repeated movements culminating in the rise of the Himalaya in Tertiary times and accompanied by igneous activity on a gigantic scale. The history of the various views which have been held concerning the Archæan complex were reviewed. In 1913 Holland produced a classification of the pre-Cambrian rocks of India which exhibits a remarkable parallelism with that given by Lawson (1913) for the pre-Cambrian of Canada. The work of the Mysore Geological Survey eliminated the fundamental gneissic complex, and showed that within the area of the Mysore State the oldest rocks were the Dhárwár system, which had been intruded into by at least four successive granite-gneisses. The Mysore Archæan succession is either incomplete, or does not fit in with the classifications of Holland and Lawson. Holland's classification dealt with a wider area than Southern India, and the essential problem appeared to be whether his Bundelkhand gneiss (Laurentian) and the Bengal gneisses (Keewatin) were older than, and unconformable to, the Dhárwár system, or whether they were post-Dhárwár eruptives corresponding with portions of the Mysore gneissic complex. On lithological grounds the Dhárwár system is divided into an Upper and a Lower Division. The former is composed largely of basic flows and sills with their schistose representatives. The Lower Division is composed of dark hornblendic epidiorites and schists, which are distinguishable from the greenstones of the Upper Division by their dark colour and practical absence of chlorite. Brief reference was made to the autoclastic conglomerates usually associated with intrusions of the Champion Gneiss, to the intrusive character of some of the quartzites or quartz-schists, and to the evidence that the limestones are due to metasomatic replacement of other rocks by carbonates of lime and magnesia. The Dhárwár schists of Mysore contain a widely extended series of banded quartz iron-ore rocks, very similar to those of the Lake Superior district.

BOOKS RECEIVED.

Our Vegetable Plot. A Year's Record. By S. Graveson. (London: Headley Bros., Ltd.) Price 7*d*. net.

Radiography and Radio-Therapeutics. By Dr. R. Knox. Part ii., Radio-Therapeutics. Pp. x+385–606. (London: A. and C. Black, Ltd.) Price 15*s*. net.

Married Love. By Dr. M. C. Stopes and others. Pp. xvii+116. (London: A. C. Fifield.) 5*s*. net.

Frontiers. By C. B. Fawcett. Pp. 107. (Oxford: At the Clarendon Press.) 3*s*. net.

Cellulose. By Cross and Bevan. New impression, with a Supplement. Pp. xviii+348. (London: Longmans and Co.) 14*s*. net.

An X-Ray Atlas of the Skull. By A. A. R. Green. Pp. x+27. (London: Longmans and Co.) 10*s*. 6*d*. net.

Analytic Geometry and Calculus. By Prof. F. S. Woods and Prof. F. H. Bailey. Pp. xi+516. (London: Ginn and Co.) 10*s*. 6*d*. net.

Equipment for the Farm and the Farmstead. By Prof. H. C. Ramsower. Pp. xii+523. (London: Ginn and Co.) 10*s*. 6*d*. net.

Everyday Physics. By J. C. Packard. Pp. vi+136. (London: Ginn and Co.) 4*s*. 6*d*. net.

Theory of Maxima and Minima. By Prof. H. Hancock. Pp. xiv+193. (London: Ginn and Co.) 10*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, April 11.

Royal Institution, at 3.—Experimental Psychology: Lt.-Col. C. S. Myers.

Institution of Electrical Engineers (Cancer Hospital, Fulham Road), at 6.—Joint Meeting with the Electrical Section of the Royal Society of Medicine.—Papers on Medical Electricity.

Institution of Mining and Metallurgy, at 5.30.—Presidential Address: Hugh F. Marriott.

Optical Society (Imperial College of Science and Technology, South Kensington), at 8.—The Balsam Problem: J. W. French.

FRIDAY, April 12.

Royal Institution, at 5.30.—Absorption and Phosphorescence: Prof. E. C. C. Baly.

Royal Astronomical Society, at 5.—The Secular Acceleration of the Sun as Determined from Hipparchus' Equinox Observations; with a Note on Ptolemy's False Equinox: J. K. Fotheringham.—Differential Transit Observations: W. E. Cooke.—The Chromospheric and Coronal Spectrum (λ 6300–λ 7600) in the Total Solar Eclipse, 1911, April 28: Rev. A. L. Cortie.

SATURDAY, April 13.

Royal Institution, at 3.—Musical Instruments Scientifically Considered: Prof. E. H. Barton.

MONDAY, April 15.

Royal Geographical Society, at 5.—Resection in Survey—The First Problem: G. T. McCaw.

Royal Society of Arts, at 4.30.—Military Explosives of To-day: J. Young.

TUESDAY, April 16.

Royal Statistical Society, at 5.15.

Illuminating Engineering Society, at 5.—Light and Vision: the Physiology of the Retina: Prof. W. M. Bayliss.

Institution of Petroleum Technologists, at 8.—Relation between Viscosity and the Chemical Constitution of Lubricating Oils: A. E. Dunstan and F. B. Thole.

WEDNESDAY, April 17.

Royal Meteorological Society, at 5.—The Variations of Underground Water-level near a Tidal River: E. G. Bilham.—Suggestions as to the Conditions Precedent to the Occurrence of Summer Thunderstorms, with Special Reference to that of June 14, 1914: J. Fairgrieve.

Geological Society, at 5.30.

Royal Society of Arts, at 4.30.—Agricultural Machinery: F. S Courtney.

THURSDAY, April 18.

Institution of Mining and Metallurgy, at 5.30.

Linnean Society, at 5.—Narrative of the Percy Sladen Expedition Brazil in 1913, with Lantern-slides: Prof. J. P. Hill.

Royal Institution, at 3.—Present-day Applications of Experimental Psychology: Lt.-Col. C. S. Myers.

Institution of Electrical Engineers, at 6.—Overseas Distribution o Engineering Appliances: L. Andrews.

Chemical Society, at 8.—Hugo Müller Lecture: The Old and the New Mineralogy: Sir Henry Miers.

Royal Society of Arts, at 4.30.—Water Power in India: A. Dickinson.

FRIDAY, April 19.

Institution of Mechanical Engineers, at 6.

Royal Institution, at 5.30.—The Use of Soap Films in Engineering: Major G. I. Taylor.

SATURDAY, April 20.

Royal Institution, at 3.—Musical Instruments Scientifically Considered Prof. E. H. Barton.

CONTENTS.

PAGE

Editorial and Publishing Offices:
MACMILLAN AND CO., Ltd.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: Phusis, London.
Telephone Number: Gerrard 8830.

THURSDAY, APRIL 18, 1918.

A MINISTRY OF HEALTH.

STUDENTS of public health have long been aware of the fact that the application to the general community of the methods of preventing and curing disease is seriously incommensurate with our knowledge of these methods. Tuberculosis we believe to be an almost, if not entirely, preventable disease, yet it is still the largest single cause of death; rickets, probably an exclusively environmental disorder, produces defects and deformities persisting through life in a large proportion of the poorer classes; infant mortality is probably exactly double what it would be if we could place every infant in a healthy environment; Sir George Newman has told us that a million school children suffer from physical or mental deficiencies, which render attempts to educate them almost useless, yet here also the physique and healthiness of the average public-school boy prove once more that the elementary-school child is the victim of pernicious surroundings.

When we turn to curative measures we find that the refinements of modern medicine, the skill of the specialist, the use of instruments of precision, and the scientific methods of diagnosis are, to a large extent, only available to the masses through the hospitals, and though these institutions are rendering services of the utmost value to the nation, they are very far from being able to meet the demand for their help owing to their limited accommodation.

The relative inefficiency of the public health and medical services in this country has been to a considerable extent concealed by the fact that since the middle of last century there has been a great decline in disease and a considerable fall in the death-rate. This improvement followed the work of Chadwick, Southwood Smith, Farr, Simon, and other pioneers of modern sanitation, and synchronised with the steady advance in the methods of disposal of sewage, removal of refuse, and provision of pure drinking water. It is no disparagement to these great names to say that modern scientific opinion tends to attribute to natural causes a larger share in the disappearance or diminution of diseases than a previous generation or even the uninstructed public of to-day would be prepared to allow. The remarkable decline in typhoid we owe almost certainly to sanitary effort, but biological influences, not yet fully understood, probably led to the disappearance of typhus, while a process of natural immunisation seems to have had at least as much to do with the decline of tuberculosis as improvements in environment and food-supply. The object of these remarks is to point out that, while we should not belittle the achievements of the past, there is distinct danger of attributing too much to our efforts and of surveying our labours with unmerited complacency. Certainly at the present day there is much in our public health administration which calls for censure rather than for praise.

In these circumstances the proposal to form a Ministry of Health is highly satisfactory, and if Dr. Addison, Lord Rhondda, and others concerned with or interested in the Bill take full advantage of their opportunities they can produce a measure of great social value. The important thing is to see that we are not satisfied with mere names or with a simple rearrangement of existing authorities, but that the scope of public health administration is widened, and that we get to grips with the bedrock causes of disease and with the means of their prevention and cure. So far as is generally known at present, the main object of the Bill is to unite or co-ordinate existing authorities, and we have heard of prolonged negotiations as to whether the Insurance Commissioners, the Local Government Board, or an entirely new body is to form the Ministry. Increased co-operation between the central administrative authorities will be all to the good, for there is no doubt that their present relative isolation leads to much delay, confusion, and unnecessary expense; but we must not suppose that departmental reorganisation, desirable though it is, will have much effect by itself in improving public health. The history of public health legislation in this country shows that two important principles should be observed if the mistakes of the past are to be avoided.

The first principle is to maintain and extend scientific research in all branches of medicine and public health. This at once raises the question of what is to be the position of the Research Committee in regard to the new Ministry. It is not yet known whether the Committee is to form part of the Ministry, but it is generally understood that the Bill immediately to be introduced is of comparatively limited scope and provides for the gradual absorption of various departments as may be found expedient. We would earnestly plead that the Research Committee should be left either entirely outside the Ministry, or, if united to it, should be practically independent and uncontrolled by any administrative branch of the Ministry. Scientific research, to be of any value, must be unfettered. Moreover, the Research Committee must have the right to investigate the results of measures taken by any branch of the Ministry and to indicate where these measures have failed to achieve their object. At the present time there is more than a tendency in many of the reports issued by Government departments responsible for public health administration to give an unduly favourable picture of the results of their work.

Another function of the research department of the Ministry should be to examine critically all proposed public health legislation. Too often have purely popular views of the causation and prevention of disease formed the basis of public health Acts, and often these views have had little scientific foundation, with the result that much time has been wasted and money uselessly spent. It is too much to hope that the Minister of Public Health will always be a member of the medical profession, but at least we may hope that the political Minister will be assisted by a professional director at the head of the administration, with an expert committee of the highest standing, and that future public health Bills will be presented to Parliament only after they have been thoroughly examined and criticised by this committee. Thus only shall we avoid repeating the failures which have been so conspicuous in recent public health legislation.

The second principle is concerned with the relation of the Ministry to local public health authorities. Here we may be anticipating, for no hint has yet been given that the local authorities are to be touched by the Bill. Yet the limitation of reform to the central authorities (if it is to be so) must be quite temporary, for without reorganisation of the local bodies which are administering public health measures the value of the Bill will be very small. It is, indeed, arguable that the start should have been made with the local authorities, leaving the reorganisation of the central departments for later consideration. A complete and really effective scheme, however, demands the co-ordination of the local sanitary authority, the insurance committee, the board of guardians, the pensions committee, and other authorities which are engaged in some form or other with public health and medical services. At present the overlapping and independent working of these bodies is productive of more confusion and delay and constitutes a greater evil than the lack of co-ordination among the central authorities. Probably the best plan would be to replace or unite all these bodies in one local authority, which in county boroughs would be the borough council, and in counties the county council, exercising some of its powers through the urban and rural district councils. The creation of entirely new local public health authorities has also been advocated.

Closely associated with this question is the proper division of power between the central and local authorities. Here, as in so many other social activities, two schools of opinion exist: one which advocates increased central control, mainly for the reason that it considers local control unsatisfactory and desires to subject the authorities to a process of "gingering up"; while the other is in favour of a large measure of decentralisation which would give local authorities increased powers at the expense of the central departments. The holding of the balance fairly between these views demands nice judgment, but in our opinion a great deal is to be said for decentralisation. In the first plaee, the larger local authorities, as, for instance, the councils of the great towns, now display a sense of responsibility for their duties and a keenness in providing healthy conditions within their area which fully justify confidence being placed in them. Indeed, the complaint is often heard that the obligation local authorities may be under to submit their proposals to a central body for approval is a serious cause of delay and inefficiency. Secondly, the local incidence of disease and the causes of disease vary so widely from place to place that a large element of elasticity in the preventive measures is necessary if appropriate remedial steps are to be taken. Centralisation of authority tends towards an undesirable uniformity over the whole country. If, on the other hand, local authorities can act on their own initiative they are in a position to establish just those systems of prevention and forms of treatment which the local circumstances demand.

The proposal to form a Ministry of Health was first made many years ago, but it has required the stimulus of a great war to bring it into being. The difficulties before the Ministry—at any time great—are now all the greater in the circumstances in which it begins its task. The supreme fact is that the introduction of this Bill definitely marks the assumption of responsibility by Government for the health of the people, and as such it will be welcomed by all who have the nation's well-being at heart.

ALCOHOL, ITS USE AND ABUSE.

Alcohol: Its Action on the Human Organism. Pp. xii + 133 + Appendix and Index x. (London: H.M.S.O., 1918.) Price 2*s.* 6*d.* net.

THE form of this little volume is a welcome innovation in Government reports, attracting, instead of repelling, the reader. Its object is to present the conclusions arrived at by a committee of the Liquor Control Board after a cold and dispassionate examination of the effects of alcohol. No statements are made without exact scientific evidence, which is clearly explained. On account of the moderation of the general tone of the book, it will probably fail to please extremists of both camps, neither of whom will be able to derive much comfort from its pages. Although the authors have been unable to find evidence of an injurious action of moderate doses, well diluted and at such intervals as to ensure the elimination of a previous dose, on the other hand they show that its action is bad when taken otherwise than as mentioned, and that it is devoid of beneficial effect in any form whatever, except in certain abnormal states to be referred to below. This point in its favour is somewhat depreciated, however, when it is pointed out that even moderate doses involve some impairment of the higher nervous functions. In one or two places the impression is given that an attempt is being made to make out the best case for it, and, on the whole, the reviewer finds himself somewhat surprised that so little is actually made out on its behalf.

The names of the committee should be given in order to show how competent it was to treat the problem in its various aspects without prejudice. They are: Lord D'Abernon, Sir Geo. Newman, Prof. Cushny, Dr. H. H. Dale, Capt. M. Greenwood, Dr. W. McDougall, Dr. F. W. Mott, Prof. Sherrington, and Dr. W. C. Sullivan.

The first chapter is devoted mainly to the explanation of certain terms used and to physiological preliminaries, which are, indeed, remarkably well done. It is pointed out that there is no mutual exclusion between the properties of a food and of a poison or drug; a substance, such as alcohol, may be both. The nature of alcohol as a food is discussed in the second chapter. It is oxidised almost completely and can afford energy for muscular work, as well as heat. But it cannot be stored, as fat and carbohydrate are stored. It has no kind of accessory action on metabolism. On account of its drug action it can only be used as a food in a restricted manner. In fact, recent work by E. Mellanby (as yet unpublished) has shown that the amount oxidised is the same whether work is done or not. It is therefore not a true foodstuff.

The chief action of alcohol is on the nervous system, and is dealt with in the third and fourth chapters. It is purely narcotic and not really stimulant. The feeling of well-being is due to the blunting of the higher faculties and the general loss of control. Its effect on the performance of all kinds of muscular acts is to delay the rate at which they are done and to reduce efficiency by impairment of skill. In this respect and in those described in the succeeding chapters, if any effect at all is produced, it is a lowering of functional activity. The nervous mechanisms themselves are sensitive to quite small quantities.

In the fifth and sixth chapters it is shown that moderate doses have no appreciable effect on digestion, respiration, or the heart. Larger doses paralyse or depress them all. The stimulant action in fainting is said to be due to an irritant effect on the mouth, precisely similar to that of ammonia on the nose. Although pure alcohol has no effect on digestion in moderate doses, certain wines appear to be deleterious. An interesting question is that of the feeling of warmth produced by it. This is really due to dilatation of skin blood-vessels, the sense-organs sensitive to temperature being situated in the skin. The actual result is a more rapid loss of heat. But here we come across circumstances in which, from the point of view of comfort, alcohol has something in its favour. If a man, after exposure to cold, is taken to warm surroundings, it can do no harm to give him the feeling of warmth, since any heat he loses is supplied from the outside.

The valuable chapter on chronic alcoholism and the cautious discussion of statistical data do not admit of a brief abstract.

On p. 127 we are told that where an emergency calls for the highest powers of perception and judgment, together with prompt action, alcohol is unequivocally detrimental, but that there are cases where a sedative action may be of advantage. Such cases, amongst others, may be when excessive fatigue results in absence of appetite or inability to sleep. These states, of course, are abnormal and ought not to occur.

On the whole it seems to the reviewer that if a man knowing nothing about the question were to pick up this volume he would scarcely be tempted to commence the consumption of alcohol. A careful study of this excellent survey of the facts is to be recommended to everyone who takes an interest in the welfare of his fellow-men, and it is to be hoped that its price will not tend to restrict the wide diffusion that the book ought to have.

W. M. Bayliss.

TWO AERONAUTICAL BOOKS.

(1) *Airfare of To-day and of the Future.* By E. C. Middleton. Pp. xv+192. (London: Constable and Co., Ltd., 1917.) Price 3*s.* 6*d.* net.

(2) *A Dictionary of Aircraft.* By W. Erskine Dommett. Pp. 52. (London: Electrical Press, Ltd., 1918.) Price 2*s.* net.

(1) THERE are two classes of aeronautical literature: books written by those who thoroughly understand their subject, and intended for the serious attention of those engaged in the industry, and books written to supply the popular demand for sensational literature on a new subject. The latter class generally show a lack of knowledge of the technical side of the subject, as is the case in the first of the works now under review. "Airfare of To-day and of the Future" is a jumble of ideas set down without attempt at law and order, and the technical matter is very often in serious error. For instance, the range of action of aircraft is stated to be about 150 miles, although the book bears the date 1917. The author has very hazy notions of stability, for he states on p. 19 that "in a cloud an aeroplane loses stability, which frequently ends in a nose-dive"! The nose-dive is, of course, due to the

pilot's loss of his sense of direction, and not in any way to changed stability of the machine. Further, on p. 22 we find: "The main condition that supplies stability to aircraft is 'lift,'" a statement that surely needs no criticism! The author appears to possess a sense of humour, for on p. 13, after cautioning the reader against the erroneous expression "knots per hour," he states that "a knot is equal to 6080 ft." The photographs illustrating the work are passable, but the diagram on p. 83 is not. It purports to illustrate the trajectory of a bomb dropped from an aeroplane, but the tangent to the trajectory at the moment the bomb leaves the machine is *vertical* instead of *horizontal*! Such errors as those in the volume under review need stern criticism, as they are liable entirely to mislead the unsuspecting reader who takes up the subject for the first time. Incidentally, there is scarcely a page of the book free from grammatical error.

(2) Mr. Dommett's "Dictionary of Aircraft" is a very different type of work, and although some of the definitions are somewhat weak, the generality are good and convey a concise idea of the meaning of the terms defined. The book is likely to be most useful to the non-technical reader, as it is scarcely full enough to be regarded as a work for technical reference. There are one or two errors which need correction; the density of air is given as 0·807 lb. per cub. ft. instead of one-tenth of that amount. Under the heading "dynamic similarity" we are referred to "similarity," but no discussion of the term appears under this latter head. The definition of dynamic stability might well be expanded, as this is a term little understood by many readers of aeronautical works. Despite these few minor faults, the work should be of considerable utility, especially to the casual reader who wants a brief definition of technical terms. The price seems a trifle high for a paper-covered handbook of fifty-two pages, even in war-time!

LIQUID FUELS.

Liquid Fuels for Internal-combustion Engines: A Practical Treatise for Engineers and Chemists. By H. Moore. Pp. xv+200. (London: Crosby Lockwood and Son, 1918.) Price 12*s.* 6*d.* net.

The rapid development of the internal-combustion engine has considerably changed our methods of power production, and liquid fuels for such engines being the most recent development, it is not surprising that their scientific study is still incomplete in respect to this method of application. The author considers it likely that the employment of liquid fuels for steam raising will entirely give place to their use in internal-combustion engines. Referring to the use of engines of the Diesel type for propelling ships, the author says that this is at present prevented through insufficient experience in building engines of very large size and of building them of low weight in proportion to the power they develop, but these difficulties, he says, are by no means insurmountable. Inexperience will be a vanishing factor, but the weight is by no means a factor to be easily overcome, being dependent on the high initial working pressures these engines require. Few engineers would care to predict the displacement of the steam turbine by Diesel engines for the high power demanded in modern battleships of even moderate size. Indeed, on the American coast there have been already cases where Diesel engines have been displaced by steam.

The liquid-fuel engine has, however, established itself firmly for a number of purposes, and the extension of the use of such engines has led to a serious shortage of suitable fuels. As the author points out, by suitable methods supplies can be enormously augmented, but the future development of these engines may be seriously retarded unless steps are taken to provide additional amounts. He instances the heavier grades of petrol, so that a larger proportion of the crude oil is available, the use of heavier fractions in vaporising engines, and the use of coal-tar products in Diesel engines

The book is divided into three parts, the last section, which comprises nearly one-half, dealing entirely with methods of examination of liquid fuels, embodying the author's experience in the laboratory of one of the largest firms of Diesel-engine manufacturers. This section will prove of considerable value to chemists engaged in fuel work.

The first part deals briefly with the raw materials which furnish the different classes of fuel—petroleum, coal tar, shale and lignite oils, etc. Part ii. deals with the fuels classified under the three types of engines in which they are applicable; those fitted with carburettors (petrol motors), those fitted with simple vaporisers (paraffin motors), and those of the Diesel and semi-Diesel type, which are fitted with fuel pumps and atomising devices. Such a method of treatment is open to objection, for many fuels are applicable to engines of more than one type—kerosene, for example, to each type. Necessarily this method leads to considerable overlapping.

Throughout the book generally there is evidence of the author's practical familiarity with the various fuels and the important characteristics to be considered in their examination. The volume will prove a serviceable guide to engineers and chemists interested in this rapidly developing phase of the fuel problem.

OUR BOOKSHELF.

Educational Reform. Speeches delivered by the Rt. Hon. H. A. L. Fisher. Pp. xvi+101. (Oxford: At the Clarendon Press, 1918.) Price 1*s.* net.

The President of the Board of Education, who has by common consent done so much to stir and enlighten the public interest in the cause of education by his numerous addresses in all parts of the country, has wisely resolved to issue in this cheap and accessible form a selection of his principal speeches, two of which he delivered in the House of Commons, the first on the occasion of presenting the Education Estimates in April, 1917, and the second on the introduction of the first Education Bill in the following August. He has accompanied the publication by a highly illuminating preface of sixteen pages, in which is resumed all the more important features of the revised draft of the Education Bill of 1918, and of the chief points of his many speeches in support of his reforms, characterised by a felicity of phrase and diction which will go far to hearten supporters of the measure and even to conciliate and win opponents. Mr. Fisher's addresses are instinct with a broad humanity and a spirit of real helpfulness. He is a man consumed with the idea that the welfare of the child is the nation's most vital concern, and his arguments and pleadings rest "upon the right of human beings to be considered as ends in themselves, and to be entitled, so far as our imperfect social arrangements may permit, to know and enjoy all the best that life can offer in the sphere of knowledge, emotion, and hope." In this faith he goes forward on his high mission, confident that he will win the support of all who desire the highest well-being of the nation.

Microscopic Examination of Steel. By Dr. Henry Fay. Pp. iv+18+Fig. 1+photographs 55. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6*s.* net.

THIS little work was originally issued by the United States Ordnance Department for the use of inspectors of ordnance material, and has now been published as a guide to others engaged in the inspection of steel. A very brief account of the equilibrium diagram of the iron-carbon alloys is given, and the reader will find it necessary to supplement this by reference to fuller treatises, in order to understand the series of photomicrographs, mostly of excellent quality, which compose the greater part of the book. The entire account of the metallic constituents of both annealed and hardened steels is compressed into five pages, and although the statements are terse and accurate they can convey a definite meaning only to readers who are to some extent prepared by previous study of the subject. It would have been well to mention the fact that only carbon steels are dealt with, otherwise such statements as that "commercially martensitic steels are unimportant on account of their extreme brittleness, and they are found only rarely," are liable to mislead. Alloy steels are met with by most inspectors in the course of their work, and a word of warning is necessary that structures which are unusual in pure carbon steels may be quite normal in some commercial products.

A few details of methods of polishing and etching are included, but we miss a reference to the newer copper reagents, which render such good service in indicating the segregation of phosphorus. A detailed description of three defective steels which failed in practice illustrates the usefulness of metallographic methods in the control of material, although a considerable amount of experience is required before it is possible to interpret aright the indications of the microscope. For the purpose of acquiring such experience, the reader is recommended to examine a number of steel specimens, the heat treatment of which is definitely known, before attempting the study of abnormalities.

C. H. D.

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.]*

Long-range Guns.

SEVERAL correspondents have rightly pointed out that the ranges given in my short article on this subject in NATURE of April 4 are twice as great as would be given by the stated initial velocities. The heading of the velocity column should have been "Horizontal Component of Initial Velocity," not "Initial Velocity." The horizontal component, where there is no resistance, is constant for the whole range.

At the end of the article I referred to the elliptic orbit of the projectile. The elements of the ellipse are easily found. Since, at the vertex of the trajectory, the weight of the projectile is just balanced by centrifugal force, and since the radius of curvature of an ellipse at the end of the major axis is b^2/a, $b^2/a=v^2/g'$, where v is the velocity in apogee and g' the earth's attraction at that distance; also, since $b^2=a^2(1-e^2)$, it follows that $e=1-v^2/R'g'$, where R′ is the apogee distance of the projectile from the centre of the earth, and

$$b=R'\sqrt{\frac{1-e}{1+e}}.$$

A short table of v and b is appended.

If $R'=R+H$, R being the earth's radius and H the greatest height of the trajectory above the earth's surface, and if, also, θ is the angular distance between the major axis of the ellipse and point where the orbit cuts the surface of the earth, the range is $2R\sin\theta$, θ being determined by the equation

$$\cos\theta=\frac{1}{R}\left(R'-\frac{H}{e}\right).$$

If the projectile has a horizontal velocity v at the surface of the earth, the table gives the approximate value of the minor semi-axis of the elliptic orbit.

v ft. per sec.		b miles	
1,000	...	158	
2,000	...	279	
3,000	...	462	
4,000	...	620	
5,000	...	780	
25,900	...	Earth's radius	Circular orbit

A. MALLOCK.

6 Cresswell Gardens, S.W.

The Motion of the Perihelion of Mercury.

I AM obliged to Mr. Harold Jeffreys for his friendly criticism (NATURE, April 11, p. 103), but my suggestion was not one of a resisting medium pure and simple, but of a resistance greater at perihelion than aphelion, and therefore synchronous with the planet's orbital period. Mr. Jeffreys will surely admit that a periodic disturbance of this kind, acting parallel to the minor axis of the orbit, would certainly affect the longitude of perihelion, without affecting the eccentricity; though whether the amount of resistance to be expected, say from matter in the Zodiacal light, is sufficient to make the effect appreciable may well be doubted. Moreover, I had not thought of the resisting medium as revolving in a planetary manner. I am inclined to attribute much more importance to my other suggestion based on the electrical theory of matter (*Phil. Mag.* for August, 1917). Nevertheless, a periodic resistance hypothesis is peculiarly applicable to Mercury, (*a*) because of its nearness, (*b*) because of the eccentricity of its orbit. OLIVER LODGE.

Relativity and Gravitation.

A MATHEMATICAL friend with whom I have been discussing Prof. Eddington's paper on "Relativity and Gravitation," recently published in NATURE, has made what appears to me to be an interesting suggestion. Prof. Eddington states that if a current of æther were moving vertically (say) with a velocity of 161,000 m./sec., a rod 8 ft. long, when placed transversely to the stream (*i.e.* horizontally), would, when turned vertically, be only 4 ft. He also says that this contraction would be unobservable because the retina of the eye would have similarly contracted in a vertical direction. Suppose, however, that the rod in its two positions were observed, not directly, but by means of a mirror inclined at an angle of 45°, by a spectator lying on his back on the floor of the room? His retina, being horizontal, would, *ex hypothesi*, have undergone no contraction at all. Both images of the rod, in its horizontal and vertical positions, would fall on this horizontal retina. If the experiment could be performed the contraction of the rod ought to be evident, and afford direct proof of the Lorentz-Fitzgerald hypothesis. Is there any flaw in this reasoning?

H. H. O'FARRELL.

IT is interesting to examine Mr. O'Farrell's plan for defeating the conspiracy to conceal the change of length of the rod; but the resourcefulness of the conspirators is equal to the occasion. A compensation will take place in connection with the reflection of the light from the moving mirror. Light rebounds from a fixed mirror as though it were a billiard ball rebounding from a perfectly elastic cushion. If the cushion were moving with a great velocity the angle of rebound would naturally be modified. That is only an analogy, but it will perhaps show that we cannot apply the rules of elementary optics to the formation of images by a mirror moving through the æther. A mathematical discussion, on the basis of Huygens's principle, shows that a change of size of the image will be introduced which compensates for the change of size of the rod. It may be remarked that in order to deflect the ray from the horizontal to the vertical direction the mirror, although apparently inclined at 45° to the horizontal, would actually (in terms of the "real" space) be inclined at 26·6° ($\tan^{-1} \frac{1}{2}$); this illustrates how the laws of reflection become modified in the conditions postulated.

A. S. EDDINGTON.

Elliptical Haloes.

THE accepted explanation of the haloes of 22° radius which are seen surrounding the sun and moon implies that they are exactly circular in form. About two years ago, however, I noticed a halo which appeared to be elliptical with the major axis vertical. I was unfortunately unable to take any measurements on that occasion, but on March 18 last a lunar halo, which was visible for a considerable time during the evening, also appeared to possess a decided, though slight, ellipticity. That this deviation from the circular form was not an illusion I was enabled to verify by noting the positions of Capella and γ Geminorum relative to the ring.

At 7.30 p.m. Capella appeared to be exactly upon the inner edge of the halo, while γ Geminorum was within the ring at a distance from it, which, as nearly as I could judge, was a quarter of the moon's diameter. From these data I find that the radii of the halo measured from the centroid of the illuminated disc of the moon through these two stars were 22·8° and 21·4° respectively. Assuming that the halo was elliptical with the major axis vertical, I deduce values of 23·3° and 21·4° for the semi-major and semi-minor axes. I am aware that a more or less complete halo the major axis of which is horizontal is occasionally seen surrounding the 22° halo, but records of haloes elongated vertically are rare. In 1908 Prof. Schlesinger noticed one the axes of which were about 7° and 4°.

Sir Napier Shaw informs me that very little is done in this country on the shapes of haloes, so that this letter may serve to direct attention to the desirability of obtaining accurate measurements. J. B. DALE.

Craigness, New Malden, Surrey, April 10.

Abnormal Catkin of Hazel.

IN February last one of my students, Miss M. Benson, brought me a flowering branch of the hazel (*Corylus Avellana*) in which one of the male catkins had a group of female flowers at the base. The other catkins were entirely male, but this one had eight female flowers, all of which appeared to be normal in structure; they were arranged like the male flowers on the same axis, but the bracts had the pointed shape of those of the ordinary female flower, and no other peculiarity was perceived. It would seem that this is the adoption of the arrangement which is the normal one in Castanea, but such cases appear to have been rarely observed in this species of Corylus, although known to occur in *C. tubulosa*. The bush was one growing on the bleak heathy moorland of Sutton Coldfield. W. B. GROVE.

Birmingham.

VOLCANIC STUDIES.[1]

THE death of Tempest Anderson in 1913, when returning from a voyage to the volcanoes of the East, removed a very familiar figure from scientific circles. For years he had made a special study of recent volcanoes, and as he was a very highly appreciated lecturer and delighted to expound his subject to popular audiences, there were very few who take an interest in geology and geography who had not had the pleasure of listening to him. He was a skilful and enthusiastic photographer, and his lectures were illustrated with beautiful lantern slides; hence it is probably correct to say that no one did more to inform the public on the subject of volcanoes during the twenty years before his death. At the Royal Geographical Society, the Geological Society, the British Association, and many local societies he was always sure of a warm welcome; and his

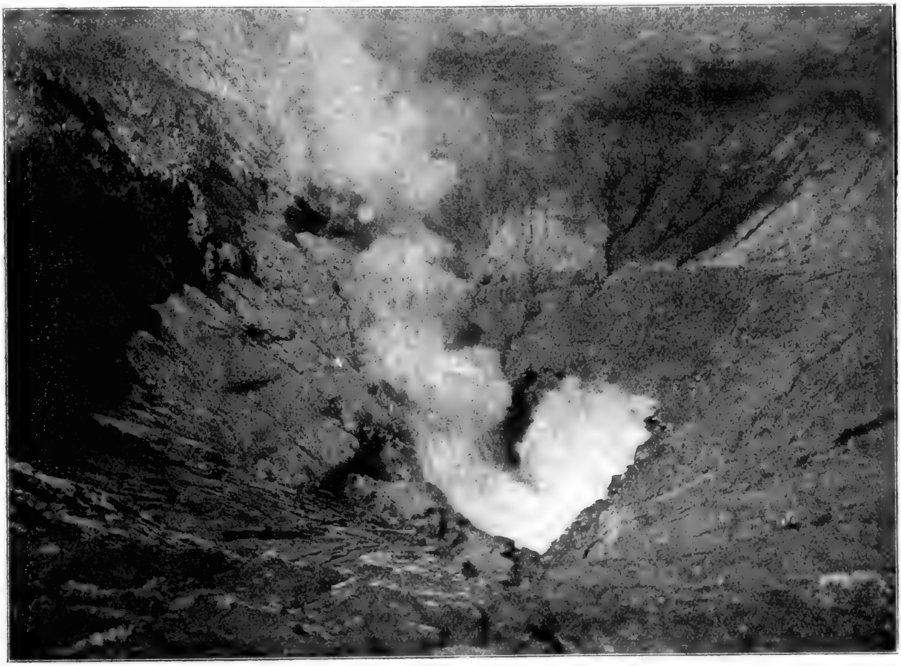
[1] "Volcanic Studies in Many Lands." Being Reproductions of Photographs taken by the Author. By Dr. Tempest Anderson. The Text by Prof. T. G. Bonney. Second Series. Pp. xv+88. (London: John Murray, 1917.) Price 15s. net.

lectures, racy with humour and crowded with adventure, were always counted among the principal features of the session's programme.

We owe to Tempest Anderson also several important contributions to the literature of volcanic geology, including a report to the Royal Society on the West Indian eruptions of 1902 and papers on the eruptions of Savaii and of Guatemala. But he was ever more ready with the camera than with the pen, and it is well known to his friends that he had an enormous number of negatives of active and extinct volcanoes, and his mind was richly stored with facts concerning them. He was a true enthusiast. When news arrived of an important eruption in Java or Savaii it was not long before Tempest Anderson had completed his arrangements to visit the spot and get some good photographs. No difficulties, dangers, ill-health, or expense daunted him; and though neither young nor very robust, he always succeeded.

This memorial volume has been edited by Prof. Bonney, one of his oldest friends, whom he always recognised as his guide and master in his investigations. It appears as the second part of a volume with the same title issued in 1903, and contains eighty-one photographs with descriptive text. A short biographical notice by Mr. G. Yeld is reprinted, with some additions, from the *Alpine Journal*. The photographs and descriptions take us over a very large field. Vesuvius, Etna, the Liparis, St. Vincent, Martinique, Mexico, Guatemala, Savaii, Hawaii, Java, Krakatau, and Luzon receive illustration in turn. Prof. Bonney's notes contain many particulars extracted from Tempest Anderson's field notes, and the book is full of interest, not only to the professed man of science, but also to all who admire beautiful or striking scenery and desire to understand its origin.

Most of the photographs are very well reproduced, though they are not all of equal merit, but this can be understood by anyone who knows the difficulty of getting good negatives on tropical expeditions and surrounded by the fumes of active volcanoes. The most interesting subjects are Krakatau as it was in 1913, Tarawera in 1913, Savaii, and (best of all in our opinion) the terrible volcanoes of Java. Some of the views taken in earlier years have been already published, and where so much was available we question whether it was advisable to reproduce them. The text is very clear and admirably suited to the pictures, but we would take exception to the explanation of the "bread-crust" bombs on p. 42. The cracked crust is due, not to the contraction of the crust or the interior, but to the expansion of the



Java. Bottom of the crater of Bromo. From "Volcanic Studies in Many Lands."

interior after the crust had hardened. Hence the resemblance to a loaf of bread, and the name. We should have welcomed also a list of Tempest Anderson's scientific papers as an appendix to the book; but the numerous references in the foot-notes to the text help to fill the gap. In paper, printing, and general get-up the volume does credit to the publisher, and as a tribute to the memory of a devoted man of science and a warm-hearted friend we hope that it will meet with a wide circle of readers. J. S. F.

SCIENCE FOR SECONDARY SCHOOLS.[1]

EVERY discussion of the educational policy to be followed in view of the present unrest lays stress on the failure of our educational methods and the paramount importance of scientific training. There are certain persons who, quite justly, point out that scientific method can be pursued in all departments of knowledge, and they conclude, not so justly, that on this account it matters little what subjects form the foundation of a liberal education; indeed, they go so far as to insist that the classical humanities are a better basis of such education than the technics of pure science can be, because in the study of mankind the experience gained from the history of the rise and fall of nations has a practical value which is essential to a stable social system.

There is no doubt that the educated mature mind may be enabled, by observation and study which follow the period of school-life, to apply the method known universally as scientific method to the problems which arise in every profession and business; but reflection will show that the very term "scientific method" denotes that such method has been drawn from special study of what are known as scientific subjects. It is not denied that it is desirable that every man and woman should acquire this method, but what is not generally appreciated is that it is a quicker, an easier, and a surer course to acquire the method through a sufficient study, carefully laid out, of such scientific facts as have laid the foundation and proved the value of scientific method. It is by such a course, begun early and carried out during the whole of the school-life, that the pupil can be led in his accompanying studies to apply the method which is not always appreciated by his teachers of those subjects.

If this is admitted to be the case it will remain to consider what sciences are essential to bring about the desired result in the pupil's mind. In deciding this momentous question there are many possibilities that should be taken into account, and the method itself insists on a survey being taken of what the schools have so far found it possible to do and what subjects have been found to appeal most strongly to the immature mind.

[1] British Association for the Advancement of Science. Report on Science Teaching in Secondary Schools. Pp. 85. (London: Offices of the Association, Burlington House, W.1, 1917.) Price 1s. net.

Here the British Association Committee has done a very useful work. The report under consideration starts by showing that the discussion is not a new one arising from the conditions into which we have been led by the war. In 1860 a Royal Commission reported on the nine public schools for boys, and recommended that the two principal branches of chemistry and physics, with further courses in physiology and natural science, should be taught in all schools for boys. The British Association in 1866 appointed a committee "to consider the best means of promoting scientific education in schools," and a report was made on "the experience gained at Rugby and Harrow, and described the position of science-teaching at Oxford and Cambridge and in French and German schools." The subject claimed attention again at the meetings in 1888, 1889, and 1890, and the need that was felt that teachers should have assistance in formulating and preparing courses of lessons led to the presentation of outlines of courses in chemistry.

Since that time a great deal has happened: science-teaching has been introduced into many schools both for boys and girls, not, however, as a part of organised arrangements for general education, but as a sort of appendix to, or in some cases a substitute for, other means of education. And in the absence of co-ordination for a well-thought-out scheme of education the teaching of science has been specialised in such a way that its influence as a part of general education has been lost. A survey of the position of science as a part of education by those who are well acquainted with the subject is therefore an important contribution to the problem that has now to be faced again as it was in 1866.

A very noteworthy part of the report is section iv., which deals with method in science-teaching. It draws distinctions between the different aspects of the teacher's appeal to the pupil under the designations of the "wonder motive" or curiosity, the "utility motive" or instinct of power, and the "systematising motive" or the instinct of reason. It lays stress upon the importance of the appeal to natural curiosity and the sense of power; it concludes with the following weighty passage:—

> Lastly, we must recognise that the "systematising motive" is one that has long been worked in our schools beyond its natural strength. Not infrequently teachers of some experience express the doubt whether boys and girls are capable of studying science before the age of fifteen or sixteen. Still more often university professors of science express the wish that their students might come to them with minds unperverted by the teaching of the schools. Whatever truth these pessimistic suggestions contain is probably accounted for by the failure of teachers to mould their instruction in conformity with the natural development of children's minds. The young man (or woman) who teaches science in schools from the point of view of the university often achieves with the best intentions a disastrous amount of harm. The mischief will not be prevented until it is universally recognised that the

logical theory of a science should be not the *terminus a quo* of instruction, but the *terminus ad quem*.

In the proper adjustment of the pupil's work, to use these three appeals for the purpose of education is the urgent problem of the teaching of science to which this committee has addressed itself. To this end curricula for schools of different types, the supply of science teachers in State-aided schools, the academic qualifications of headmasters, and the methods of inspection and examination are all discussed in a very readable and useful report.

THE FUTURE OF SCIENCE IN WALES.

THE recently issued Report of the Royal Commission on University Education in Wales will, there seems no doubt, mark the beginning of a new era in higher education in the Principality. Into the past history of the University and colleges and the causes which led to the setting up of a Royal Commission we cannot enter here. We are concerned with the future and, more especially, with the provision to be made for the development of scientific and technological training.

From the very first it was recognised that "science, especially in its applications to arts and manufactures, should occupy a prominent place in the curriculum of the colleges," and provision was made by all three colleges in Wales for the teaching of pure science. The further development of teaching and research in pure science is left to the reorganised University and colleges, which, it is hoped, will be provided with ampler funds for this purpose. We learn, however, that, "as the requirements in pure science became satisfied, the special needs of the neighbouring localities began to claim the attention of the colleges"; and the demand has arisen for the further development of teaching and training in applied science. It is earnestly to be hoped that, as a result of the recommendations made by the Commission, the University and colleges of Wales will be able to develop their work in these branches to a level unsurpassed by any other British university.

As regards the prominence of the demand for increased provision for technological and vocational studies, wise words of warning are spoken by the Commissioners which all interested in true University education and in the highest development of our industries would do well to ponder and lay to heart:—

Although it is right that the universities should be looked to as schools of preparation for professional life, it would be fatal if they allowed preoccupation with this task to weaken their hold upon the principle that they are intellectual trustees for posterity, keeping safe and, where possible, adding to the stock of universal knowledge which the past has entrusted to their care. . . . Some people have been inclined to complain that the universities turn out graduates who with all their attainments are not always immediately serviceable in commerce and industry: a right view of what a university training seeks to do for its students would suggest to such people that even their own utilitarian aims would not be really served by importing a more definitely technical element into the university student's course. As year by year commerce and industry become more complex and far-reaching in their ramifications, the value of a sound grasp of principles grows more indispensable to those concerned in their higher operations, and any loss on this side would be but ill made up by a slightly earlier familiarity with the specialised technique of a particular trade or calling, which after all is easily and rapidly acquired by a mind properly grounded in principles.

We commend these words to the careful attention of the people of Wales.

In Mid and North Wales, which are largely agricultural in character, we find that in the colleges of Aberystwyth and Bangor agriculture has for long been included among the subjects of the college curricula. But with regard to the fuller development of their agricultural departments which both colleges desire to promote, important pronouncements are made by the Commissioners. The present three years' degree course, it is maintained, which is primarily based on science, is inadequate for teachers and experts, because the student does not obtain that thorough grounding in pure science which would qualify him to undertake fruitful research work after he has obtained his degree. Such a student would do better to obtain his degree in one of the pure science departments and then pass over to the agricultural department for some general training in agriculture, coupled with investigation in his special subject. He requires, in fact, at least a five years' course, and his agricultural training should in the main be post-graduate. Since for this purpose elaborate provision of staff and equipment is needed, such advanced training should be concentrated at a single college. For the working farmer a new type of degree course is required, based more upon economics and history than upon pure science, and this course should be provided at all constituent colleges undertaking agricultural teaching and advisory work. A department of animal pathology should be established as part of the College of Medicine at Cardiff.

With regard to forestry, future developments will depend on the policy of the Government in respect to afforestation. It is, however, laid down that forestry should in the main be treated as a post-graduate subject, and, for reasons of economy, should be associated with the post-graduate department of agriculture at whichever college this department may be located.

In South Wales, as is natural, the demand is mainly for further development in technological training in engineering, mining, and metallurgy; and a scheme has been drawn up for the constitution of a faculty and board of technology. According to this scheme, which is accepted in its broad outlines by the Commission, the Municipal Technical College of Swansea would become recognised as a fourth constituent college of the University; and, subject to the fulfilment of certain conditions designed to secure a satisfactory standard, post-secondary institutions and departments doing advanced work might be recognised as providing part of the courses for a distinct technological degree which the University would establish.

By the institution of this new faculty and board, on which the local industries would be represented, it has been sought to meet "the strong feeling of distrust entertained towards the University and centralised control by certain industrial and commercial interests in South Wales." In relation to the University this new faculty and board "should have all reasonable liberty to bring their special knowledge and experience to bear on what will often be local problems, but they cannot claim to be given a greater degree of independence than that enjoyed by a constituent college. It is conceivable, for example, that individuals or associations may desire to place large sums of money at the disposal of the board, and that by these means, or in other ways, the faculty and board of technology might be able to give a bias to the general development of the colleges or to the character of courses for degrees which would be contrary to the general principles upon which our recommendations are framed and inconsistent with any real control on the part of the University or the colleges." The Commissioners utter this warning:—

But there is a serious danger lest short views should be taken of the true function of the university, and of the nature of the contributions to the common good which it is most fitted to make. Great advances in the application of science to industry have often been made possible by the discoveries of students who had no such object in view, but were impelled simply by the desire to extend the bounds of knowledge and solve some problem in the realm of pure science.

With regard to the development of medical studies it is recommended that the proposed National School of Medicine should be organised as an independent constituent college of the University governed by a council and senate of its own. Towards the erection of the necessary buildings the sum of 90,000*l.* has been promised by a private donor, and the gift of a further sum of 30,000*l.* has recently been announced for the endowment of a chair of preventive medicine.

On the financial side it is recognised that, in order to carry out all the legitimate developments of the work of the University and its colleges, an additional annual income of about 100,000*l.* will be necessary, to be raised by increased local subscriptions and private gifts and by a proportionate increase of the Government grant; and it is held that increased remuneration and provision for superannuation for the teaching staffs of the colleges constitute a foremost claim on such increased revenue.

The principles and recommendations put forward by the Commissioners afford an excellent opportunity for renewed effort, and if the people of Wales will rise to the height of their opportunity, higher education in science and technology is assured of a bright future in the Principality.

ANATOMICAL NOMENCLATURE.

At a recent meeting of the Anatomical Society of Great Britain and Ireland steps were taken to clear up the chaos which has overtaken the nomenclature employed by human and vertebrate anatomists in this country. In 1889 the Anatomical Society of Germany appointed a commission to prepare a revised nomenclature—one which was finally adopted by the society when it met at Basle in 1895, and hence known as the "Basle Nomina Anatomica," usually spoken of as the B.N.A. nomenclature. The majority of British anatomists have never favoured or accepted the B.N.A. nomenclature, not because of its origin, but because of its intrinsic defects. The French and Italian anatomists also refused to adopt it. Unfortunately, the Basle terminology has been adopted in our leading English text-books on human anatomy, while the majority of teachers have continued to use the terminology which is native to Britain. The result has been to introduce a state of chaos bewildering to the pupil as well as to the teacher.

The resolution passed unanimously by the Anatomical Society at its meeting in King's College on March 1 is a definite pronouncement against the adoption of the Basle nomenclature by British anatomists. The terms of the resolution were as follows:—

This society sees no reason for departing from the use of the old nomenclature as the recognised medium of description for employment in anatomical text-books and departments or by medical men in general. On the other hand, it thinks there are very good reasons to be urged against the adoption of any other nomenclature for this purpose.

NOTES.

The Bakerian lecture of the Royal Society will be delivered on Thursday, April 25, by Sir Charles Parsons, on "Experiments on the Production of Diamond." Sir Charles Parsons will also describe his experiments on the formation of the diamond at the eighth annual May lecture which he is to give before the Institute of Metals on May 2. In view of the special character of the occasion, the council of the Institute of Metals has decided to make this an open meeting. Persons desiring to be present should apply —enclosing a stamped and addressed envelope—for cards of invitation to Mr. G. Shaw Scott, 36 Victoria Street, S.W.1.

The council of the Royal Society has appointed a committee to investigate and report on the possibility of obtaining and replacing food materials and other necessaries by the utilisation of natural products not hitherto generally employed for such purposes. Suggestions as to such products and the means of organising their collection should be addressed to the secretary of the Natural Products Committee, Royal Society, Burlington House, Piccadilly, London, W.1.

The secretary of the Decimal Association informs us that at the annual meeting of the Associated Chambers of Commerce held on April 9 and 10 a motion was adopted urging the Government to pass into law the Decimal Coinage Bill prepared by the Executive Council of the Associated Chambers of Commerce in conjunction with the Institute of Bankers and the Decimal Association. It is understood that Lord Southwark will introduce the Bill into Parliament at the earliest possible moment.

The possibility of an aerial mail has often been commented upon in these columns, and it is very interesting to note that a company has actually been formed in Norway for the purpose of establishing a mail service between Aberdeen and Stavanger. This trip was made just before war broke out by Capt. Tryggve Grau in about five hours' flying, and it is estimated that the mail services will reduce this to four and a half hours with modern machines. An extension of the system to Christiania and Copenhagen is contemplated, and it is hoped that letters leaving Aberdeen in the morning would be delivered in both these cities in the afternoon. The company has already a share capital of 150,000*l*., and a representative is now in England negotiating with the Government for a solution of the problem. The value of such a mail service would be very great at a time when the oversea service is so seriously hampered by the German submarine campaign, and the satisfactory establishment of the contemplated Norwegian service would undoubtedly soon lead to a general use of the aeroplane for rapid international communication.

We learn from *Science* that by joint action the United States Secretaries of War and the Navy, with the approval of the Council of National Defence, have authorised and approved the organisation, through the U.S. National Research Council, of a Research Information Committee in Washington with branch committees in Paris and London, which are intended to work in close co-operation with the officers of the Military and Naval Intelligence, and the function of which shall be the securing, classifying, and disseminating of scientific, technical, and industrial research information, especially relating to war problems, and the interchange of such information between the Allies in Europe and the United States.

For the duration of the war and one year afterwards (according to *L'Economista d'Italia* for April 2) there has been established at the Italian Ministry of Commerce and Labour an office entitled "Office of the Committee for Chemical Industries," which will fulfil the following functions:—It will (1) act as the executive body for all the deliberations of the Committee for the Chemical Industries; (2) compile statistics bearing on the Italian production of chemical and pharmaceutical supplies, especially in regard to raw materials; (3) collect information relative to the progress of industrial chemistry abroad; (4) publish information of interest to the Italian chemical industry; (5) investigate any new measures or modifications of measures proposed in Italy or abroad of interest to industrial chemistry; (6) take any necessary preliminary steps to get Parliament to adopt the best measures to secure the most effective collaboration between science and the chemical industry; (7) take any other steps necessary to the interests of the chemical and pharmaceutical industry of the country.

An account of the outbreak of pneumonic plague in China is given by a correspondent in the *Times* of April 12. The epidemic, which commenced last December, has a firm hold on a part of the Mongolian plateau and in the high-lying part of North Shansi, but so far has not spread to the populous centres in North China. It was not until pressure had been brought to bear upon the Chinese authorities that precautionary measures were taken; these consist in quarantining those who come from infected districts, and the immediate isolation of the sick and their treatment by masked attendants. The course of the epidemic is traced, and it is surmised that marmots have been the source of infection. The mortality has been considerable, but exact figures are lacking; in the Suiynan district 1500 deaths were reported up to the beginning of February.

The first meeting of the Inter-Allied Scientific Food Commission was, we learn from the *British Medical Journal*, held in Paris on March 25 and the following days. At the first sitting the Commission was received by M. Boret, the French Minister of Agriculture and Food. In his opening address M. Boret pointed out that the object of the conference is to study the best means of utilising the very small food resources at the disposal of the Allies so as to effect an equitable distribution of the available food supplies among the Allies, having proper regard to the facts of physiology and political economy. The Commission agreed to establish a permanent central secretariat in Paris, M. Alquier being appointed secretary. In addition to the central secretariat it was agreed that a secretary to the Commission should be appointed in each of the Allied countries. The Commission considered important questions relating to the minimum food requirements of man, and to the production and distribution of food supplies. The Commission will reassemble at intervals, in Paris or in some other of the Allied capitals. It will probably meet next at Rome towards the end of this month. The formation of the Commission was decided upon at an inter-Allied conference held in Paris last November, when it was resolved that the Commission should consist of two delegates each from Great Britain, France, Italy, and America. The delegates appointed from the various countries were:—Great Britain: Prof. E. H. Starling and Prof. T. B. Wood; France: Prof. Ch. Richet and Prof. E. Gley; Italy: Prof. Bottazzi and Prof. Pagliani; America: Prof. R. H. Chittenden and Prof. Graham Lusk. The Commission is empowered to make any propositions to the Allied Governments which it thinks fit.

The President of the Local Government Board recently appointed a Committee, under the chairmanship of Sir John Tudor Walters, "to consider questions on building construction in connection with the provision of dwellings for the working class in England and Wales, and to report upon methods to secure economy and despatch in the provision of such dwellings." The Committee has approached the Department of Scientific and Industrial Research with the request that the Department would make arrangements to undertake any research work which might be found desirable to assist in the prosecution of these inquiries. The Advisory Council for Scientific and Industrial Research accordingly appointed a Committee consisting of Mr. Raymond Unwin (chairman), Mr. R. J. Allison (on the nomination of the First Commissioner of H.M. Office of Works), Mr. P. A. Crosthwaite (on the nomination of the Local Government Board), Mr. W. H. Humphreys, and Mr. Seebohm Rowntree, with Mr. E. Leonard, of the Local Government Board, as secretary. In order that the services of suitable technical advisers should be at the disposal of this Committee, Mr. Tabor, an engineer of the London County Council, has been appointed by the Department technical officer to the Committee, while, with the concurrence of the Board of Education, the services of Mr. Hugh Davies, H.M.I., have also been made available. The terms of reference to the Committee are as follows:—"To make arrangements for carrying out researches on building construction instituted by the Department at the instance of the Local Government Board Committee or otherwise, to be responsible under the council for the direction of such researches, and to deal with such other matters as may be referred to them from time to time by the council."

MR. MACPHERSON, Parliamentary Under-Secretary for War, in a written reply to Mr. Lynch, who asked in the House of Commons whether it is possible to construct a gun capable of throwing a projectile eighty miles or more, and, if so, whether steps have been taken in consequence, has stated that it is possible to construct such a gun, and that the necessary steps have been taken.

REPLYING to a question as to the ages of the small-pox patients now being treated in the hospitals of the Metropolitan Asylums Board, and the vaccinal condition of each patient, Mr. Hayes Fisher, President of the Local Government Board, has given the House of Commons the following information:—The condition as to vaccination of the thirty-four cases in question at the time of exposure to infection was as follows:—Under five years of age, four cases, all unvaccinated. Between five and fifteen years, ten cases, all unvaccinated. Between fifteen and twenty-five years, four cases, all unvaccinated. Between twenty-five and thirty-five years, six cases, all vaccinated, none revaccinated. Above thirty-five years of age, ten cases, all vaccinated, of which two are stated to have been revaccinated several (more than twenty) years previously. Of the total thirty-four cases, fifteen were vaccinated or revaccinated after exposure to infection.

Engineering for April 12 comments upon the memorandum issued recently from which it appears that the net cost of the Army in 1916–17 was 587,796,567*l*., of which enormous total the sum of 285*l*. was appropriated to inventors. The disproportion recalls Falstaff's famous reckoning, where one poor halfpennyworth of bread figured as an item amongst an intolerable deal of sack. The remark has often been heard that this is an engineers' war, but the above account would convey the impression that the authorities are as reluctant as ever to encourage the application of original thought to the improvement of our material of war. Fortunately, engineers and scientific men have actively exerted their patriotic efforts without consideration of personal profit, and hence, whilst the account may state truly the amount paid for ideas, it affords no criterion for estimating the actual value of the services rendered by inventors, which have in many cases been given gratuitously.

BY the death at the age of seventy-three of Prof. Paul Vidal de la Blache France has lost her foremost geographer. For many years Prof. de la Blache held the chair of geography at the Sorbonne, where his lectures had attracted students from many countries. He was one of the first to introduce causal treatment into geography, and, emphasising always its human side, to raise it to the rank of a scientific study. He was the author of numerous geographical works, and for several years had been one of the editors of the *Annales de Géographie*. Of his many works the best known is probably his "Atlas général Vidal de la Blache," which appeared in 1890 and succeeding years. This atlas, which contains about 137 maps, including fifty-two historical maps and many insets, is the standard French atlas. Many of the maps are marked by great ingenuity of conception, and several are unique to this atlas. Prof. de la Blache also showed much interest in historical geography, and among his earlier works was one on Marco Polo. His last work, published in 1917, entitled "France de l'Est," discussed the geographical basis of the history of Alsace-Lorraine. Prof. de la Blache was a member of the French Institute.

MR. GEORGE MITCHELL SEABROKE, who died suddenly on April 1—his seventieth birthday—was educated at Rugby School in the house of Mr. J. M. (now Canon) Wilson, under the headmastership of Dr. Temple. No doubt he owed much to Canon Wilson's inspiring teaching, both of science and mathematics, as well as a personal friendship which lasted his whole life. On leaving school he was articled to Mr. M. H. Bloxam, solicitor and clerk to the magistrates of the Rugby Petty Sessional Division, to whose practice and clerkship he succeeded in 1871. Mr. Seabroke's scientific and mechanical tastes showed themselves in early youth. There was, and probably is still, a model steam engine which he constructed in the 'fifties, preserved in the cabinet of physical apparatus in Rugby School. At the same time he was interested in astronomy, and requiring an instrument more powerful than a $3\frac{1}{4}$-in. refractor, he invented and constructed a machine for grinding and polishing glass specula. This enabled him to construct a 9-in. reflecting telescope, still preserved as a supplementary instrument in the Temple Observatory, and chiefly used for spectroscopic work. Of the Temple Observatory of Rugby School, founded by the energy of Canon Wilson in 1871, Mr. Seabroke was the first curator, a position which he held until his death. In 1870 he was elected a fellow of the Royal Astronomical Society, and contributed to the publications of the society papers on spectroscopic observations on the motion of the fixed stars in the line of sight and on the micrometric measure of double stars. He took an active part in the formation of the British Astronomical Association. He was elected on the first council, was president 1910–12, director of the double-star section 1902–15, and of the Saturn section 1898–1911. This is not the place to describe Mr. Seabroke's public work for the town of Rugby during the last forty-five years, but it may be mentioned that he was an active commander of the volunteer corps and was given the rank of Hon. Lt.-Col. of the 2nd Warwickshire Volunteer Battalion. He also took a leading part in the co-ordination of fire brigades, which led to the establishment of the National Union of Fire Brigades, of which he was one of the founders. Elected to the old Rugby Board of Health in 1875, he soon took in hand the task of supplying Rugby with a plentiful supply of pure water, to the maintenance of which he paid constant attention. A few weeks before his death he was made deputy-lieutenant of the county of Warwick.

THE death is announced of Mr. Robert Winthrop Blackwell, one of the best-known pioneers of electric traction, whose name has been equally familiar in this country and in the United States during the last thirty-five years. Mr. Blackwell was born in 1858, and educated at Princeton University, where he was a contemporary of President Wilson. He afterwards practised at the American Bar, and was attracted into electrical work in 1883, when he founded the Bentley Knight Electric Railway Co., which installed an electrically operated tramway system in Cleveland, Ohio; this line, opened in 1884, was the first commercial line operated electrically. Mr. Blackwell took up his residence in this country in 1890, and founded the firm of Robert W. Blackwell and Co. in 1894. This firm secured the contract for the Bristol electric tramways in 1895, and the great success of this undertaking paved the way for many others. His name will be remembered on account of the excellent quality of the work carried out under his direction, and for the kindly assistance and advice which he was always ready to offer. He was a member of many clubs, and was in charge of most of the arrangements for looking after the American Military Mission during its visit to this country.

We regret to note that *Engineering* for April 12 records the death of Mr. John Shanks Brodie, who since 1900 had been the borough engineer and surveyor of Blackpool. Mr. Brodie was born in 1850, and acted as engineering assistant from 1877 to 1884 to the Corporation of Liverpool. During the following sixteen years he occupied the positions of borough, harbour, and waterworks engineer at Whitehaven. Among many other improvements carried out at Blackpool under his direction are the sea-walls, designed by Mr. Brodie and executed under his direct supervision. It would be difficult to find around our coast sea-defence works carried out in a more thorough manner. Mr. Brodie was elected a member of the Institution of Civil Engineers in 1906.

According to an announcement in the *Times* of April 6, the Royal Agricultural Society is entering upon an important development of its activities in the prosecution of agricultural experimental investigation. For several decades the society has carried on valuable work on its experimental farm at Woburn, but it is realised that many important practical problems cannot be adequately dealt with at a single centre. Members of the society are being invited, therefore, to co-operate with the view of carrying out experiments under the widely differing conditions prevailing in various parts of the country. Among the subjects for investigation referred to in the preliminary announcement are the continuous growing of corn, green manuring, unexhausted manurial value, the use of lime, the treatment of pasture, and calf-rearing. These subjects afford abundant scope for the practical investigator, but the value of the work accomplished under the scheme will depend largely upon the detailed arrangements for the planning and supervision of the work, further information concerning which will be awaited with interest.

The report of the council of the Institution of Mining and Metallurgy for the year ended December 31 last, presented at the annual meeting held on April 11, records the increasing inclination of Government departments to turn to scientific and technical organisations for advice and assistance. The council is preparing to deal with problems of reconstruction after the war. Co-operation between the leading scientific and engineering societies has increased, the report points out, and augurs well for future developments. Substantial progress was made during 1917 in the tin and tungsten research inaugurated by the institution with the co-operation of the Royal Cornwall Polytechnic Society, and carried out under the direction of the committee of which Sir Thomas Rose is chairman. In connection with the organisation of the mineral resources of the Empire the council has done useful work in urging the establishment of a Department of Minerals and Metals. The Imperial War Conference which met in London during the spring of 1917 decided that it was desirable to establish in London an Imperial Mineral Resources Bureau, upon which should be represented Great Britain, the Dominions, India, and other parts of the Empire. The bureau should be charged with the duties of collection of information from the appropriate departments of the Governments concerned and other sources regarding the mineral resources and the metal requirements of the Empire, and of advising from time to time what action, if any, may appear desirable to enable such resources to be developed and made available to meet the metal requirements of the Empire. The committees appointed by the various Government Committees have recognised the necessity for such a central organisation, and the council awaits the final decision of the Government.

In the issue of *Man* for April Dr. A. C. Haddon discusses the outrigger canoe of East Africa. Canoes with outriggers are confined to the Indo-Pacific area, and are absent, and so far as we can tell always have been, from the American continent and Europe. Canoes with single outriggers are unknown in Africa, while canoes with double outriggers are confined to the east coast, from Lamu to Dar-es-Salaam, to the Comoro Islands, and to the north-west coast of Madagascar. Their occurrence in this region is certainly due to a cultural drift from Indonesia, which also brought in its train a peculiar form of fish-trap. Mr. C. W. Hobley, through Mr. H. R. Montgomery, District Commissioner, East Africa, has supplied Dr. Haddon with an interesting account, furnished with numerous illustrations, of the East African type of canoe. Further information, both from East Africa and Indonesia, is required before the question of the origin of this type of canoe can be regarded as definitely settled.

At a meeting of the Zoological Society on March 5 Mr. Tate Regan exhibited photographs of a fish with markings on the tail simulating old Arabic characters, on one side "Laillaha Illalah"—"There is no God but Allah"—and on the other "Shani Allah"—"A warning sent from Allah." The fish was sold in the market at Zanzibar for a penny; the man who bought it was going to eat it and cut off the tail, throwing it on the ground; another man picked up the tail and saw the writing; great excitement ensued, and the fish changed hands at increasing prices, until 5000 rupees was offered. Major H. R. Cartwright, Commandant of Police, had the fish preserved and sent photographs of it to the Natural History Museum, where it was identified as *Holacanthus semicirculatus*, Cuv. et Val., a widely distributed Indo-Pacific species of Chætodontidæ. Mr. Regan considered the markings as falling within the limits of normal variation of the species.

Under the title "Our Ill-fed Foes" the *Illustrated London News* of March 23 devotes a page to illustrations, drawn by Mr. W. B. Robinson, of some of the food substitutes used in Germany. The more thoughtful reader who will carefully examine his drawings may, however, learn many lessons which he will find distinctly beneficial in these days of rations and dear foods. We have before us also a paper written a year ago by Dr. F. A. Bather (of the Natural History Museum) in the *Putney News Letter*, advocating the use as vegetables of several of our common weeds, notably the dandelion and stinging-nettle, and sprouts of hops. The present writer can speak from experience as to the excellence of the young nettle-tops when served like spinach, and the attempt to weed the garden of dandelions is greatly stimulated by the reward of daily after-dinner coffee made from ground and well-roasted roots. Dr. Bather also recommends nettle soup, and dandelions stewed, while the latter are often eaten in salad by travellers abroad. Of the other "vegetables" depicted in the *Illustrated London News* we regard sorrel as a great delicacy; "Good King Henry" and watercress are too well known to require comment, but meadow-cress, herb Barbarea, and scurvy grass seem well worth trying, and without following the German practice of roasting the roots of "Lords and Ladies" (which are poisonous when raw), it would be very interesting to try using them for starching our shirts and collars. The German coffee substitutes shown in the diagram referred to include asparagus seeds and ground acorns; of these we are informed that the latter are often used in Switzerland; but quite a long list of other German substitutes, both for coffee and for tea, is given. Apparently hops and beech leaves form the staple substitutes for tobacco in

Germany. But in the matter of health, as well as of economy, advantages are to be gained by substituting dried coltsfoot leaves (either smoked in a pipe or made into cigars) for the more insidious narcotic. Mr. Robinson's diagrams do not include fungi, but judging from the British species, these would fill many pages of the *Illustrated London News*. Instead of pitying our "ill-fed foes," we might learn a good many interesting lessons from their dietary.

The Board of Agriculture has issued a leaflet (Food Production Leaflet, No. 34) on the canning of fruit and vegetables which should be very useful to the large number of growers and others who are desirous of preserving the largest possible quantity of fruit and vegetable food for winter use. The leaflet deals specially with the use of small canning plants suitable for domestic use by amateurs or small fruit-growers. The instructions given for every stage of the process are sufficiently detailed to ensure a reasonable prospect of success for the veriest tyro. Demonstrations are given daily at 11.30 a.m. in the Canning Kitchen, Food Production Department, 72 Victoria Street, S.W.1, and, in addition, periodical demonstrations are arranged in provincial centres. The necessary outfit of steriliser and cans can be obtained from the Department on terms which are explained in the leaflet.

A somewhat original method of reinforcing metals is described in the *Engineer* for April 12. The process has been devised by Mr. C. W. Denny, and lends itself to the manufacture of tubes and plates. It consists in reinforcing with perforated steel, of suitable thickness, weaker metals such as copper and lead. In making reinforced copper sheets, the perforated steel plate is prepared by any well-known method for electro-deposition, and, finally, copper-plated to any required thickness, the deposition of copper going right through the holes and forming a sheet of copper with the steel core inside. It is claimed that a plate so formed will stand bending and pressing without the copper leaving the steel. In some cases the copper can be rolled on hot. In producing reinforced lead plates it has been found practicable to roll or press the lead into the perforations.

Messrs. Henry Frowde and Hodder and Stoughton have in the press "The Medical and Surgical Aspects of Aviation," by H. Graeme Anderson.

Messrs. Witherby and Co. announce an important book which should be of interest to ornithologists, viz. "A Monograph of the Pheasants," by W. Beebe. The work, which is being published under the auspices of the New York Zoological Society, embodies the author's own observations and information from other sources, and will contain many coloured plates and maps; also photographs showing the pheasants of the world, their haunts, changes of plumage, nests, and eggs. There will be four volumes, the first of which is to be issued next month.

A useful catalogue (New Series, No. 82) of books of science has just been issued by Messrs. J. Wheldon and Co., 38 Great Queen Street, Kingsway, containing 1328 titles of works relating to astronomy, chemistry, electricity, engineering, mathematics, meteorology, and physics, and, in addition, particulars of sets of many scientific journals. The catalogue will be sent to any applicant for the sum of twopence.

Messrs Newton and Co., 72 Wigmore Street, W.1, are offering for sale the collection of microscope slides (some 650 in all) formed by the late Mr. Lewis Wright. A classified list, with the prices asked, will be sent by Messrs. Newton upon application.

OUR ASTRONOMICAL COLUMN.

The April Meteor Shower.—There is reason to believe that this display may be more abundant than usual at the ensuing return on about April 21. Of late years it has been very disappointing, and very few true Lyrids appear to have been seen since 1901. The radiant point is like that of the August Perseids, for it exhibits a diurnal shift of 1° to the eastward, the positions on successive nights being:—

	° °			° °
April 17	... 265+33		April 23	... 274+33
18	... 267+33		24	... 275+33
19	... 268+33		25	... 276+33
20	... 270+33		26	... 278+33
21	... 271+33		27	... 279+33
22	... 272+33		28	... 280+33

The stream has been observed with certainty between April 16 and 26, but it has very probably a longer duration than that.

This meteoric shower has a cometary connection, for the first comet of 1861 shows a suggestive similarity of orbit, but the periodic time of revolution, either of the comet or meteoric shower, is not exactly known. There were rich displays of Lyrids in 1803, 1851, 1863, and 1884. This year moonlight will interfere somewhat with the phenomenon, as, at the time of the maximum, our satellite will be a little past the first quarter, and above the horizon until between 2h. and 3h. in the morning.

Tempel's Comet.—The following ephemerides of Tempel's first periodic comet have been constructed by Dr. A. C. D. Crommelin on three assumptions of the date of perihelion passage in 1918: (A) May 9·37; (B) May 17·37; (C) May 25·37. The ephemerides are for 9 p.m.

	A		B		C	
Date	R.A.	S. Dec.	R.A.	S. Dec.	R.A.	S. Dec.
	h. m. s.	° ′	h. m. s.	° ′	h. m. s.	° ′
April 17	16 51 18	16 30	16 32 4	14 48	16 12 36	12 55
25	16 52 6	17 9	16 31 44	15 25	16 11 4	13 26
May 3	16 50 54	17 55	16 29 20	16 3	16 7 39	14 2
11	16 47 52	18 43	16 25 5	16 48	16 2 33	14 40
19	16 43 26	19 34	16 19 41	17 36	15 56 28	15 25

Search should be made along a line through positions A, B, C, or this line produced. The values of $\log \Delta$ on hypothesis B are 0·0959, 0·0749, 0·0574, 0·0440, 0·0357 for the five dates. This comet has not been seen since 1879, so there is considerable uncertainty as to its position.

Absorption and Radiation of the Solar Atmosphere.—A paper by Prof. Shin Hirayama appears under this title in the Proceedings of the Tokyo Mathematico-Physical Society, second series, vol. ix., p. 236. Utilising observations of the radiation from different parts of the solar disc which have been made by Abbot, Prof. Hirayama computes the transmission and radiation of the solar atmosphere, on Schuster's supposition that a great part of the solar radiation comes from an absorbing and radiating layer above the photosphere. It is shown that the observations are better represented in this way than by the previous calculations of Biscoe, in which the radiation of the atmosphere was not considered. The coefficient of transmission increases gradually with the wave-length, and the radiation due to the atmosphere ranges from one-third of the whole radiation for the shorter wave-lengths to nearly one-half as the wave-length increases. Assuming the effective temperature of the sun to be 6000° Abs., it is calculated that the temperature of the photosphere is about 7040°, while that of the absorbing layer is 5210°.

THE POSITION OF NATURAL SCIENCE IN EDUCATION.

THE report (Cd. 9011, price 9*d.* net) of Sir J. J. Thomson's Committee appointed in 1916 to inquire into the position of natural science in the educational system of Great Britain has now been published, and we propose to deal with its main points in a later issue. It is a valuable survey of the position of science in schools and in relation to professional and university education. The case for increased attention to science in order to expand the mental outlook as well as equip the nation with the elements of industrial progress is so strong that it has already convinced all who have considered it. What remains to be done now is to act upon the principles set forth in the report, and if the stress of war has not shown the necessity for such action by our political rulers national disaster will do so when too late. It is pointed out that there has been no general and sufficient recognition of science as an essential part of the curriculum for all boys in the public schools, and that in grant-aided secondary schools the customary course of science work is too narrow, to the neglect of great scientific principles with their human interests and everyday applications. More trained scientific workers are needed; and to secure them there must be a generous extension of the system of scholarships and greatly increased contributions from the State for university and technical education. "If," says the report, "the universities are to discharge their responsibilities towards the science students who are coming, and to maintain their position as homes of scientific learning and research, they must receive a measure of financial support much more considerable than they have received hitherto." The report concludes with a summary of principal conclusions under eighty-three heads, a selection from which is reprinted below.

General.—Natural science should be included in the general course of education of all up to the age of about sixteen. Real progress in education depends on a revolution in the public attitude towards the salaries of teachers and the importance of their training. A large increase in the number of scholarships at all stages of education is necessary.

Secondary Schools.—Steps should be taken to secure for all pupils in State-aided secondary schools a school life beginning not later than twelve and extending at least up to sixteen. Science should be included in the general course of education for all pupils in public and other secondary schools up to the age of about sixteen, and this general course should be followed by more specialised study, whether in science or in other subjects. In all secondary schools for boys the time given to science should be not fewer than four periods in the first year of the course from twelve to sixteen, and not fewer than six periods in the three succeeding years. Increased attention should be given to the teaching of science in girls' schools. In girls' schools with a twenty-four-hour school week not fewer than three hours per week should be devoted to science in the period twelve to sixteen. A larger number of State-aided schools should be encouraged to provide advanced instruction in science, and those which undertake advanced work should be staffed on a more generous scale. The elements of natural science should be a necessary subject in the entrance examination of public schools, and due weight should be given to this subject in the entrance scholarship examinations to public schools.

Science Course Twelve to Sixteen.—The science work for pupils under sixteen should be planned as a self-contained course, and should include, besides physics and chemistry, some study of plant and animal life. More attention should be directed to those aspects of the sciences which bear directly on the objects and experience of everyday life. There should be as close correlation as possible between the teaching of mathematics and science at all stages in school work. The present chaos of English weights and measures causes waste of time and confusion of thought, and there are strong educational reasons for the adoption of the metric system. All through the science course stress should be laid on the accurate use of the English language.

Science Course Sixteen to Eighteen.—The amount of time devoted from sixteen to eighteen to the subject or subjects in which a pupil is specialising should be not less than one-half or more than two-thirds of the school week. Pupils specialising in science should continue some literary study, and those specialising in literary subjects should give some time to science work of an appropriate kind. Pupils who do advanced work in science should be enabled to acquire a reading knowledge of French and German. Eighteen should be the normal age of entry from secondary schools to the universities, and the age limit for entrance scholarships at Oxford and Cambridge should be reduced to eighteen.

Examinations.—In the First School Examination all candidates should be required to satisfy the examiners both in mathematics and in natural science. In this examination there should be co-operation between the teachers and examiners, and weight should be attached to the pupil's school record.

Teachers in Secondary Schools.—It is essential that the salaries and prospects of teachers in secondary schools should be substantially improved and a national pension scheme provided. A full year's training shared between school and university is necessary for all teachers in secondary schools.

Laboratories.—The teachers in State-aided schools should be given freedom and responsibility in the selection and purchase of laboratory appliances up to a fixed annual amount.

Elementary Schools.—Increased attention should be given to the provision of suitable instruction in science in the upper standards of elementary schools. A larger number of students in training colleges should be encouraged to take advanced courses in science. There should be in every elementary school a room in addition to the ordinary classroom accommodation available for work in science and other practical subjects.

Technical Education.—Greater efforts should be made to develop and increase the provision of instruction in pure and in applied science in technical schools and institutions of all grades. Many more scholarships are needed to enable technical students to pass on to the universities, and also to enable boys from junior technical schools (or their equivalent) and from evening schools to enter senior technical schools. The position of junior technical schools in the educational system should be reconsidered. It is essential that the salaries and prospects of teachers in technical schools should be substantially improved, and a national pension scheme provided for whole-time teachers. In the proposed continuation classes provision should be made for instruction in science both in its general aspects and in its bearing on industry.

Medicine.—The First School Examination should be recognised by the General Medical Council as qualifying for entrance into the medical profession. Students should be allowed to take the First Professional Examination in (*a*) chemistry and physics, and (*b*) biology before entering the university or medical school. More scholarships should be provided for candidates of both sexes tenable throughout the medical course.

Engineering.—A thorough and practical training in mathematics and science is essential to the school education of engineers; it cannot be replaced and need not be supplemented at school by practice in an engineering workshop.

Agriculture.—Specific instruction in agriculture or agricultural science should not be given in elementary or secondary schools, though in favourable circumstances a rural bias may be given to the work of a secondary school. All county education authorities acting either singly or in co-operation should provide well-equipped farm institutes for their areas.

Army.—Science should be an obligatory subject in the examination for entrance into the Royal Military College, Sandhurst, and be included in the course of instruction in the college. Steps should be taken to improve the efficiency of the instruction in science at the Royal Military Academy, Woolwich. More encouragement should be given to officers at later stages of their career to improve their scientific qualifications.

Home and India Civil Service.—An inquiry should be made as to the best methods of securing the services of scientific men for the purposes of the State in permanent posts and otherwise. Many permanent posts can best be filled by men selected, not by the ordinary competitive examination, but at a riper age on the ground of high scientific qualifications and professional experience. All candidates for the competitive examination for these services should supply evidence of a continuous course of training in science extending over several years. To ensure sufficient catholicity in questions propounded in the *viva-voce* examination, these examiners should include some representative of science.

University Education.—The universities should adopt the First School Examination as the normal examination for admission, and should abolish special matriculation examinations for candidates from schools. Greek should not be retained as a necessary subject in Responsions at Oxford or the Previous Examination at Cambridge. The universities should make special arrangements to test the fitness for entrance of candidates who are above twenty-three years of age.

Degree Courses in Science at the Universities.—The Universities of Oxford and Cambridge should arrange to provide more suitable courses in science for candidates who do not aim at an honours degree. Candidates for the university intermediate examinations should be allowed to take the examinations from school. The universities should recognise the Second School Examination as alternative to the whole or part of their intermediate examinations. It is desirable that a year spent mainly on research should form part of the work of university students preparing for careers concerned with science and its applications; but this should follow the course for a first degree in science. Scholarships are needed to enable a young graduate to spend a year or more in research, at his own or at another university.

State Aid to the Universities.—Large expenditure of public money is necessary to equip the universities for their work in pure and in applied science. Grants from public funds to the universities should be increased to allow the universities to make a substantial reduction in their fees.

University Teachers.—The duties of junior demonstrators should be limited so that they can spend a considerable amount of time on research. There should be posts of substantial value in university departments for senior men whose best work lies in teaching. The heads of technological departments should be allowed to undertake private professional practice.

Scottish Universities.—Steps should be taken to remove the limitations which confine a large proportion of the old-established bursaries to the faculty of arts.

Scholarships at Schools and Universities.—Scholarships should be considered as distinctions awarded in recognition of intellectual merit and promise. All scholarships should be of nominal value, to be supplemented according to need. Where necessary the whole cost of a scholar's education and maintenance should be defrayed. Scholarships at the universities should be tenable for at least three years with a possibility of extension. Scholarships awarded by local education authorities should not be restricted to particular universities. Scholarships at the universities should be awarded on a wider range of subjects than at present. The age limit for scholarships at Oxford and Cambridge should be eighteen rather than nineteen. Scholarships should not be awarded on work done in large pass examinations for schools. Scholarships to the universities for candidates from technical and evening schools should be awarded without an age limit, and for the present on a limited range of subjects. The number of scholarships at the women's colleges should be increased. Loan funds should be established to enable senior students to obtain professional training.

Supply of Trained Scientific Workers.—Concerted efforts should be made by employers, teachers, local education authorities, and the State to increase the flow of capable students to the universities and higher technical institutions with the view of securing the larger supply of trained scientific workers required for industrial and other purposes.

APPLICATIONS OF ELECTRICITY TO MEDICINE.

THE Institution of Electrical Engineers devoted an evening meeting last week to a visit to the Cancer Hospital, Fulham Road, S.W. The occasion was a joint meeting of the members of the institution and the members of the Electrotherapeutic Section of the Royal Society of Medicine. Two papers were read by medical men, and there was a large and representative exhibition of radiographic and electrical apparatus used in the diagnosis and treatment of disease.

The modern and thoroughly well equipped research institute of the hospital, under the direction of Dr. Alexander Paine, was thrown open to the visitors, who had an opportunity of seeing the inner working arrangements of several laboratories equipped for research work in physics, pathology, bacteriology, chemistry, and other subjects associated with the investigation of disease by modern methods.

The governing body of the Cancer Hospital has always exercised a wise judgment in the adoption of new methods for the investigation of the causation of disease, its diagnosis and treatment. This hospital was one of the first in this country to recognise the therapeutic use of X-rays and other electrical methods in the treatment of malignant disease. So far back as 1903 it inaugurated a very complete X-ray department, which was carried on for several years under the directorship of Dr. J. D. Pollock.

In 1911 the research institute was ready for work, and a year or two later the scheme for modernising the special branches of the hospital work was completed by the equipment of the new electrical and radiotherapeutic department, which is housed in a separate pavilion, connected to the main building and wards by corridors. These two buildings complete a scheme for the investigation and treatment of disease which is one of the most complete in this or any other country.

In the radiotherapeutic department are to be found the latest forms of electrical apparatus. These allow a wide range of wave-length for the treatment of disease by radiations, commencing with the ultra-violet radiation to the very penetrating γ ray of radium. The hospital possesses a large quantity of radium, which is in constant use in the department. Originally inaugurated for the treatment of patients suffering from cancer and allied diseases, the department was, at the outbreak of war, offered to, and accepted by, the War Office for the treatment of wounded soldiers. Of these a large number have been treated by X-rays, radium, and electrical methods, this work being carried on in addition to the ordinary work of the department.

An interesting development in radium therapy has been inaugurated in this department, a number of soldiers having been treated by radium and X-rays for keloid scars of the face and neck. These result from gunshot wounds, and frequently require plastic operations to restore the parts destroyed by the injury. Radiation treatment greatly aids the surgeon in his operative efforts by softening the scar tissue. A number of cases have been successfully treated in this way.

The use of electricity in the treatment and diagnosis of disease is well shown by the various forms of apparatus seen in the radiographic and radiotherapeutic department. High-tension transformers and large coil outfits are used for the energising of the X-ray tubes, of which a number are in daily use. The Coolidge tube is used exclusively for treatment. Diathermy and other forms of high-frequency apparatus are used for the relief of pain and for the surgical treatment of disease. Continuous and interrupted currents are used for the treatment of diseases and injuries of muscles, bones, and joints.

The radiographic side of the work was demonstrated in the large radiographic room, where a Siemens single-impulse apparatus was shown at work in conjunction with a Coolidge tube. A new piece of apparatus, designed by Mr. C. A. Holland, was also shown. This is a stereoscopic plate-changing stand which allows of two plates being exposed in about half a second. It is worked by a large flywheel, which actuates a mechanism for changing the plates, shifting the tube, and automatically making the exposure. This will be found to be extremely useful when stereoscopic plates of the thorax or abdomen are required, where it is essential that no great interval should elapse between the two exposures.

Two papers were read and discussed at the joint meeting; these very appropriately dealt with recent applications of electricity to medicine. Diathermy—the use of the electrical current to raise the temperature of the body in the treatment of disease—was the subject of a paper by Dr. E. P. Cumberbatch. A very clear description of the action of the high-tension current, the method of its production, and the uses to which it can be put in practical work claimed the appreciative attention of the audience. Diathermy is one of the most recent of the many electrical methods used in the treatment of disease; when its value is more fully realised by the medical profession, and the technique of its application is more developed, it will undoubtedly become a routine and valuable method for the treatment of diseases which are at present uninfluenced by other forms of treatment. It is a valuable agent to use in combination with X-rays and radium.

The second paper was on "Single-impulse Radiography: its Limitations and Possibilities," by Dr. R. Knox, director of the electrical and radiotherapeutic department of the hospital. The limitations of the apparatus at present in use were demonstrated, and a plea was made for help in the designing and production of more powerful apparatus.

In addition to the permanent apparatus in the hospital a number of new forms of electrical apparatus were exhibited by several firms. These attracted a good deal of attention and amply demonstrated that the manufacturers of this country can produce high-class apparatus equal to the product of any other. Given closer co-operation between physicists, electrical engineers, medical men, and manufacturers, it should be possible in the future for British manufacturers more than to hold their own in open competition with other countries.

The meeting was well attended by a large number of the members of the Institution of Electrical Engineers and of the Electrotherapeutic Section of the Royal Society of Medicine. The council of the institution is to be warmly congratulated on the success of the meeting, and it is to be hoped that it may be the forerunner of many more of a similar character.

SILVANUS THOMPSON MEMORIAL LECTURE.

At the meeting of the Röntgen Society held on April 9, with Capt. G. W. C. Kaye, president, in the chair, Sir Ernest Rutherford delivered the first Silvanus Thompson Memorial lecture. He dealt with the important advances in our knowledge of the constitution of matter, resulting from the discovery of X-rays in 1895. The following brief abstract indicates the scope of the address.

The discovery of the X-rays marks the commencement of a new epoch in physical science, for in the attempts which were immediately made to ascertain the nature of the unknown radiation attention was directed to the study of radiation in general, and new phenomena were soon encountered. A general investigation of the cathode rays and of the nature of the discharge of electricity through gases led to the discovery of the "electron" and to the putting forward of the "ionisation theory" by Sir J. J. Thomson. Prof. Townsend followed up the initial work by his theory of ionisation by collision, and Prof. O. W. Richardson investigated the emission of ions from incandescent solids. All this work was originally of academic interest solely, but within the last few years the practical applications have been shown to possess immense value. These include the production of detectors and amplifiers for wireless telegraphy, electrical rectifiers and oscillators by which radiotelephony across the Atlantic is now possible, and the Coolidge X-ray tube, which is destined to play an important part in radiology and in pure science.

From the outset X-rays and the phenomena of phosphorescence were generally thought to be connected, and Becquerel, while in search of "invisible" or X-radiations from certain phosphorescent salts, discovered the radio-activity of uranium compounds. The brilliant researches of the Curies, by which this discovery was followed, resulted in the isolation of the radio-active elements, polonium and radium. Numerous other radio-active elements were brought to light, and the chaotic condition which ensued was not reduced to order until the introduction of the transformation theory by the lecturer. Difficulties regarding the periodic classification were overcome by Prof. Soddy, who applied the term "isotope" to substances which occupy the same place in the periodic table, but cannot be separated chemically, and the atomic weights of which may differ slightly.

With regard to the study of the X-rays themselves, no outstanding advances were made for some ten years after their discovery, when Barkla obtained evidence of the existence of "characteristic" radiations from experiments on secondary X-rays. The discovery led to the wave-theory of the X-rays, which was completely substantiated at later dates by the diffraction experiments of Laue, the Braggs, Moseley, and Darwin. Barkla's characteristic rays are thus shown to be of the same nature as the rays yielding bright-line spectra in the case of ordinary light. The diffraction experiments led to the employment of the X-rays for two classes of investigation, in the hands of Prof. Bragg and his son, problems of crystal structure have been successfully attacked, while in the other direction the late Mr. Moseley has shown these phenomena to be a most powerful method of investigating the constitution of the elements. He showed that the critical property of an element was its atomic *number*, while its atomic weight was relatively of secondary importance. The important relationship between the frequency of the K or L series of characteristic rays and the atomic number of the element should be known as Moseley's law.

At the conclusion of the meeting the president presented to Sir Ernest Rutherford the first of the medals which will be given annually in commemoration of the Silvanus Thompson Memorial lecture.

SCOTTISH METEOROLOGY.

The Journal of the Scottish Meteorological Society for 1916 retains the interesting character it has held of recent years. There are four articles besides the report of the council, and the statistical information, with fifteen pages of letterpress, on the weather of 1916 in Scotland.

Capt. Douglas gives a very interesting account of his observations on clouds as seen from an aeroplane, but as this was the subject of an article in the issue of Nature for April 4 it is unnecessary to say more about it here.

The second article is by Mr. M'Cullum Fairgrieve, and discusses a chart suggested by Dr. Griffiths Taylor, and called by him a climograph. The chart is formed by plotting the mean monthly wet-bulb temperature against the mean monthly humidity on squared paper, and joining in order the twelve points so formed. The idea originated with Prof. Huntingdon, who was investigating the effect of climate upon the mental and physical fitness of a race. Both Mr. Fairgrieve's and Dr. Taylor's papers should be read—it is impossible in a brief space to give extracts; they are both very interesting, but the criticism that occurs to one is that the magnitude and prosperity of a big city do not depend very largely on its climate, but rather on its geographical position. Thus, Edinburgh or Liverpool has probably just as good a climate as London or New York, but the preponderance of the latter cities depends chiefly on other considerations.

Dr. Crighton Mitchell, in the third article, discusses the time of the occurrence of the maximum and minimum temperatures at Eskdalemuir. He has taken the frequencies at each hour of the day, and so formed a frequency table for each month. The standard deviation of the time of maximum is much less in the summer than in the winter. For the summer the time of maximum is 2 p.m. and the standard deviation 2·55 hours. For the winter these values become 1 p.m. and 5·85 hours. As at other stations, the minimum mostly occurs about the time of sunrise.

In the fourth article Mr. Smillie and Mr. Watt discuss a curious case of ground-ice which caused much inconvenience by blocking the inlet of a public water supply. The trouble occurred at Lochrutton Lock, near Dumfries, and is the only similar case recorded there, although many more severe frosts have occurred since the construction of the waterworks. There was no surface ice on the lock at the time, the inlet became clear, and no further trouble was experienced as soon as the surface was frozen. The authors discuss the reason of the formation of ground-ice and show that it is probably due to radiation.

The rest of the journal contains notes, reviews of current literature, a list of fellows, and a statement of accounts, as well as an interesting description of the weather of each month by Mr. Watt.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The Foreign Secretary and the President of the Board of Education have invited representatives of universities to attend a conference to be held on May 9 to consider the possibility of establishing closer connection between British universities and those of the Allied countries. The proceedings will be private.

In recognition of his services to the cause of science the sum of two lakhs of rupees was recently presented to Sir J. C. Bose, of the Presidency College, Calcutta, by some of the leading citizens of Bombay. In accepting the gift Sir J. C. Bose stated that it would be held in trust by a committee of three for the use of the Bose Institute.

The Department of Agriculture and Technical Instruction for Ireland will next June award a limited number of trade scholarships. The object of the scholarships is to enable selected persons who have been engaged in certain industries in Ireland, for a period of at least two years, to obtain systematic instruction in the principles of science and art as applied to these industries. By this means it is hoped that the standard of workmanship will be raised and the industries, as well as the scholarship holders, thereby benefited. Candidates must be recommended by the managers of the industries in which they are employed, and must produce an undertaking from the managers to the effect that the latter will re-employ them after the termination of the scholarships. Scholars must also undertake to resume their employment on the termination of the scholarships. Scholarships will not be awarded to apprentices whose apprenticeships will normally terminate within the period of the training course. The scholarships will be tenable for one school session, and will be of the value of 1*l*. per week during the period of instruction, together with class-fees and travelling expenses. Candidates unable to produce evidence of a satisfactory general education will be required to pass a simple qualifying examination in English, arithmetic, and drawing, and the standard will be equivalent to that of the sixth standard of the Board of National Education. For the session 1918–19 the industries selected are typography, cabinet-making, loom tenting, motor engineering, plumbing, and woollen manufacture.

A paper on "Technical Education in India: its Past and Future," was written by Mr. E. F. Tipple, of the Thomason Civil Engineering College, Roorkee, U.P., for the Indian Industrial Conference held in Calcutta in December, 1917. Mr. Tipple urged that practical education in India has been much neglected, and that courses for the technical education required for the management of industries should be provided, and also the lower industrial training suitable for the actual workers. These appear to be essential if any progress is to be made, but India has lagged behind in most industrial matters. The existing system of family industrial training from generation to generation, which finally merges into the "caste" system, might be worked upon as the groundwork of the lower industrial training; but the higher technical education has been entirely neglected, possibly because, as Mr. Tipple points out, higher or university education in India has largely fostered courses which provide persons mainly equipped for Government service as lawyers, clerks, etc., but not for practical pursuits. He also deplores the fact that education in Indian schools has been arranged to lead up to university education of a literary type. He suggests that an Indian secondary-school career, instead of ending with an examination which is intended as an "entrance" into the existing universities, should end with a "school final examination." In such a school final a varied preliminary training suitable for diverse careers, such as industrial, commercial, and trade pursuits, might be provided for. This reform has been strongly urged during at least the last twenty years, and is essential if India is to hold its own in industrial work. It is to be hoped that the Indian University Commission, which has been taking evidence in different parts of India for some months, will give a much-needed lead towards more practical forms of education in India in the future.

A copy of the annual statement of the Rhodes Trust for 1916–17 has been received from the secretary of the trust. It is recorded that the war has interfered increasingly with the operation of the scholarship system. At the close of 1916 the American section of the scholarships was still barely affected; but on the entry of the United States into the war the difference between American and Colonial Rhodes scholars naturally ceased to exist. The trustees have decided to postpone for the present all further election to scholarships. This will not, however, interfere with the holding of the annual qualifying examination in the United States, or in Colonies where qualification is not obtained through affiliation of local universities with the University of Oxford. Altogether, there were in residence at Oxford for some part of the year eighty-five Rhodes scholars, of whom seventy-one were American and fourteen Colonial. Of the seventy-one Americans, the great majority are now serving in the United States Army. For 1917–18 there are at present eight Rhodes scholars in residence—six Colonial and two American. Of the six Colonials, five are medical students; and of these five, two have already seen service. Of the two Americans, one has returned from a year's ambulance work on the French front, and is temporarily engaged in Government work in the University chemical laboratory, while the other has been rejected, on medical grounds, for military service. In addition, one ex-scholar has returned after three years' military service in France, to complete his medical course. The scholarships set free under the Act of Parliament cancelling the German Rhodes scholarships have been allotted as follows:—One to the Transvaal; one to the Orange Free State; one to Alberta and Saskatchewan (which have hitherto had only one between them); and one to Kimberley and Port Elizabeth alternately (Kimberley to select in the first year). Fourteen scholars and ex-scholars have given their lives in the service of the Empire during the year, and others have won many military honours. Five scholars were admitted in the year to read for advanced degrees. The address of the trust is Seymour House, Waterloo Place, London, S.W.1.

SOCIETIES AND ACADEMIES.

London.

Optical Society, April 11.—Prof. F. J. Cheshire, president, in the chair.—J. W. **French**: The balsam problem. For cementing optical parts together Canada balsam is almost invariably employed. Although starting or starring of the balsam layer, actual separation of the parts, or deformation of the optical surfaces frequently occurs, there is no appreciably better substance known. Optical parts may be combined with an air space between the surfaces, by optical contact with or without sealed edges, by optical welding, or by cementing. The disadvantages of the various methods were enumerated, the loss of light at transmission surfaces being particularly discussed. A considerable number of balsamed specimens of ages varying up to ten years had been opened and photomicrographs of the balsam layer were exhibited. In all cases there were fluid layers between the harder balsam and the glass surface, and the photographs demonstrated particularly the smallness of the adhesion to the glass. Specimens artificially produced were also exhibited. In many cases the age of the specimen was shown to be deducible from the configuration. So-called granulation of balsam was stated to be due to the action of moisture on the balsam surface. No trace of crystallisation of glass-quality balsam was found in any of the experiments, but a number of the photographed specimens showed definite right-angled fractures occasionally observed in torn gelatine films.

Paris.

Academy of Sciences, March 25.—M. Paul Painlevé in the chair.—A. de **Gramont**: The spectrum test for boron. The bands obtained in the Bunsen flame, with or without the addition of hydrochloric or sulphuric acid, are diffuse and insensitive; the use of the oxy-acetylene flame gives additional bands, but still diffuse. The lines of boron given by the condensed spark are characteristic and more delicate, and the presence of three lines only in the ultra-violet shown by Sir William Crookes is confirmed. The line $\lambda = 2497 \cdot 82$ will just detect 1 in 100,000 of boron. Applications to metallurgy and mineralogy are given.—C. **Depéret**: An attempt at the chronological co-ordination of quaternary times.—S. **Lattès**: The repetition of rational fractions.—M. de **Pulligny**: Some values of the approximate quadrature of the circle.—G. **Claude**: The industrial preparation of argon. A method of fractional condensation and distillation of air is described by means of which a mixture is obtained continuously containing argon 75 to 80 per cent., nitrogen 1 to 2 per cent., the remainder being oxygen. The oxygen is readily removed by burning with the correct proportion of hydrogen.—M. **Travers**: The estimation of tantalum in its alloys with iron. The impure tantalic acid obtained by the usual method is freed from iron by fusion with caustic potash, and after igniting and weighing the tantalic acid, the silica still remaining is determined by volatilising the tantalic acid in a current of hydrochloric acid at 900° C.—F. **Zambonini**: The identity of shattuckite and plancheite.—A. **Guébhard**: The notion of "geosynclinal."—A. **Polack**: Inversion of the Purkinje phenomenon in congenital hemeralopy.—Ch. J. **Gravier**: A new copepod, *Flabellicola neapolitana*, parasite of a polychetal annelid, *Flabelligera diplochaitos*.—L. **Binet**: The cerebral pulse in emotional states.

April 2.—M. Paul Painlevé in the chair.—L. E. **Bertin**: Obituary notice on Lord Brassey.—P. **Appell**: The notion of fixed axes and of absolute movement.—P. **Termier**: Contributions to the knowledge of the tectonic of the Asturias; the signification of the Arnao mylonites.—P. E. B. **Jourdain**: Demonstration of a theorem on ensembles.—L. **Schlussel**: The value of the accelerations and velocities of dynamical actions registered by the dynamometer.—A. C. **Vournasos**: A new metastable form of antimony tri-iodide. Pure glycerol at its boiling point dissolves 20 per cent. of antimony tri-iodide, and deposits it on cooling as an amorphous powder, a fourth metastable modification of this substance. At 172° C. it is completely transformed into the stable form of hexagonal crystals.—R. **Charpiat**: The glauconite sands of the Lower Lutetian, in the north-east of the department of the Marne.—A. **Lécaillon**: The manner in which *Psammophila hirsuta* captures and carries its prey, and the rational explanation of the instinct of this Hymenoptera. The sense of smell is suggested as the means by which the prey is detected.—A. **Durand**: Correlation between the phenomena of condensation and smell. The author gives reasons for the view that water vapour plays a part in the mechanism of smell.

BOOKS RECEIVED.

The Young Observer's Handbook. By W. P. Westell. Pp. 317. (London: McBride, Nast, and Co., Ltd.) 7*s.* 6*d.* net.

Carnegie Institution of Washington Year-Book, No. 16. Pp. xvi+358. (Washington: Carnegie Institution.)

Club Types of Nuclear Polynesia. By W. Churchill. Plates xvii+pp. 173. (Washington: Carnegie Institution.)

Forecasting the Yield and the Price of Cotton. By Prof. H. L. Moore. Pp. vi+173. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.)

The Aviation Pocket-Book for 1918. By R. B. Matthews. Pp. xvi+362. (London: Crosby Lockwood and Son.) 6*s.* net.

Welfare and Housing. By J. E. Hutton. Pp. viii+192. (London: Longmans and Co.) 5*s.* net.

Carnegie Institution of Washington. Papers from the Department of Marine Biology. Vol. xii. Pp. v+258. (Washington: Carnegie Institution.)

The Interferometry of Reversed and Non-reversed Spectra. By Prof. C. Barus. Part ii. Pp. 146. (Washington: Carnegie Institution.)

European Treaties bearing on the History of the United States and its Dependencies to 1648. Edited by F. G. Davenport. Pp. vi+387. (Washington: Carnegie Institution.)

Applied Bacteriology. Edited by Dr. C. H. Browning. Pp. xvi+291. (Oxford Medical Publications.) (London: H. Frowde and Hodder and Stoughton.) 7*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 18.

ROYAL INSTITUTION, at 3.—Present-day Applications of Experimental Psychology: Lt.-Col. C. S. Myers.
ROYAL SOCIETY OF ARTS, at 4.30.—Water Power in India: A. Dickinson.
INSTITUTION OF MINING AND METALLURGY, at 5.30.
LINNEAN SOCIETY, at 5.—Narrative of the Percy Sladen Expedition to Brazil in 1913, with Lantern-slides: Prof. J. P. Hill.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Overseas Distribution of Engineering Appliances: L. Andrews.
CHEMICAL SOCIETY, at 8.—Hugo Müller Lecture: The Old and the New Mineralogy: Sir Henry Miers.
MATHEMATICAL SOCIETY, at 5.

FRIDAY, APRIL 19.

ROYAL INSTITUTION, at 5.30.—The Use of Soap Films in Engineering: Major G. I. Taylor.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.

SATURDAY, APRIL 20.

ROYAL INSTITUTION, at 3.—Musical Instruments Scientifically Considered: Prof. E. H. Barton.

MONDAY, APRIL 22.

ROYAL SOCIETY OF ARTS, at 4.30.—Military Explosives of To-day: J. Young.
ARISTOTELIAN SOCIETY, at 8.—Behaviour as a Psychological Concept: Prof. A. Robinson.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Transkei: Miss M. H. Mason.

TUESDAY, APRIL 23.

ROYAL INSTITUTION, at 3.—Barrow-Explorers: Prof. A. Keith.
ROYAL STATISTICAL SOCIETY, at 5.15.—The Industrial Position of Italy: Prof. Commendatore Attolico and Capt. F. Giannini.
INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Annual General Meeting.
ZOOLOGICAL SOCIETY, at 5.30.—Report on the Deaths in the Gardens during the Year 1917: Dr. J. A. Murray.—Exhibition of Specimens Illustrating the Effects of Rickets: Prof. Wood-Jones.

WEDNESDAY, APRIL 24.

ROYAL SOCIETY OF ARTS, at 4.30.—Mental Effects of the War and their Lessons in Social and Medical Reconstruction: Sir Robert Armstrong-Jones.

THURSDAY, APRIL 25.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Experiments on the Production of Diamond: Sir Charles Parsons.
ROYAL INSTITUTION, at 3.—Rheims Cathedral: Sir Isambard Owen.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Large Batteries for Power Purposes: E. C. McKinnon.

FRIDAY, APRIL 26.

ROYAL INSTITUTION, at 5.30.—Food Production and English Land: Sir A. Daniel Hall.
PHYSICAL SOCIETY, at 5.—Notes on the Pulfrich Refractometer: J. Guild. —The Accuracy attainable with Critical Angle Refractometers: F. Simeon.—Cohesion: Dr. H. Chatley.

SATURDAY, APRIL 27.

ROYAL INSTITUTION, at 3.—Modern Investigation of the Sun's Surface: Prof. H. F. Newall.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, APRIL 25, 1918.

SOME "INTELLECTUAL ADVENTURES."

(1) *The Self and Nature*. By DeWitt H. Parker. Pp. ix+316. (Cambridge, Mass.: Harvard University Press; London: Humphrey Milford, 1917.) Price 8*s*. 6*d*. net.

(2) *Locke's Theory of Knowledge and its Historical Relations*. By Prof. J. Gibson. Pp. xiv+338. (Cambridge: At the University Press, 1917.) Price 10*s*. 6*d*. net.

(3) *The Problem of Creation: An Attempt to Define the Character and Trend of the Cosmic Process*. By the Right Rev. Dr. J. E. Mercer. Pp. xiii+325. (London: S.P.C.K., 1917.) Price 7*s*. 6*d*. net.

(4) *Originality: A Popular Study of the Creative Mind*. By T. Sharper Knowlson ("Thomas Sharnol"). Pp. xvi+304. (London: T. Werner Laurie, Ltd., 1917.) Price 15*s*. net.

(1) IN reading Prof. Parker's book we breathe that delightful and invigorating atmosphere of the New World which seems the vital condition of American philosophy. We are not startled with new doctrines or confronted with strikingly original theories. The problems are all familiar enough, whether they are old or new, yet the author makes us feel that we are out on "an intellectual adventure," and though we are journeying through a well-charted country we are bent on discovery. The book is pervaded throughout with the spirit of William James, the father of all such as dwell in philosophical tents and go forth on philosophical pilgrimages. James produced no system, introduced no new method, stereotyped no principle, had none of those qualities we associate with the founders of schools, and yet no philosopher of our generation lives on in his influence so definitely and so directly as he. The joy of living is in every word he has written. Few philosophers contradicted themselves more often or set forth with the full confidence of conviction so many inconsistent theories, yet few have had so many and so varied a following.

Prof. Parker's book is a general treatment of metaphysical problems, especially of the central problem of the nature and unity of mind, and the method is described as "radical empiricism extended through the imagination." To summarise the author's views on the problems would serve no purpose, and would destroy the main charm, which is the personal freshness of the treatment.

(2) By way of contrast there is something of the stolid British nature, as well as sound and original philosophy, in Prof. Gibson's study of Locke's theory of knowledge. It is a work of deep and penetrating scholarship, which must have occupied many years of the author's life, and yet it is written with a lucidity and charm which make the reader unconscious of the erudition.

The "Essay" of the great English philosopher still suffers, we are told, "from the twin assumptions that it can be understood without being studied, and that its full significance can be summed up in a small number of simple propositions." This is true, no doubt; but of what great classic could not the same be said? Prof. Gibson means, we suppose, that he would like to see Locke's "Essay" more regularly included among the set books of Philosophy Honours Courses. There are only two ways of approaching the study of the great philosophies. One is to study a special work as a compendium of precise knowledge. In this way the Catholic seminaries teach the philosophy of St. Thomas Aquinas. The other is to study a philosophy as the historical expression of an ever-changing problem, ever-changing because, like life itself, it never attains finality. If Locke's "Essay" suffers peculiar injustice because it is generally taken as read, on the other hand, when it is closely studied for its own sake, we have to be constantly on guard lest we read into it concepts and developments of concepts which did not become explicit until long after. To understand the philosophy of a bygone age we must recognise that for that age it was fully concrete. We must install ourselves within the historical conditions, and not merely know the historical relations. Then we shall cease to lament the absence of our cherished concepts, and not continually bewail the "unfortunate" orientation of the author's mind.

Prof. Gibson has brought out with great clearness the predominant concept which determined the form and direction of Locke's philosophy—the idea of composition. To the philosophers of his age the main task of philosophy seemed to be the discovery of the simple ideas out of which the complex and complicated ideas had arisen, and to reveal the nature of the aggregation and agglutination. This notion of composition dominated the intellectual outlook as completely as the notion of evolution dominates the thought of our time.

What we seem to miss in this thoroughly scholarly and most useful introduction to the study of the father of English philosophy is the true note of the historical concept. The chapters on the historical relations, excellent as they are, are not historical judgments in the full philosophical meaning; they are comparisons with systems which preceded and systems which have followed.

(3) The "intellectual adventure" to which the Bishop of Tasmania invites us in his "Problem of Creation" is of another order. We have the feeling of being on a personally conducted tour rather than on a voyage of discovery. We are shown the wonders of Nature, taken into perilous places, made to look into volcanoes, and cross torrents; we get thrills, and yet all the time we feel we know that there is no real danger. Dr. Mercer, nevertheless, propounds a serious argument, and very ably sustains it. He holds firmly the principle *ex nihilo nihil fit*, and his purpose is to reconcile it with the orthodox view of creation, with the concept of God, and with the ethical principle of freedom. He also discusses its bearing on the problem of evil. Dr. Mercer is not, however, always a guide to be depended

upon when he expounds scientific theory. It is a little disconcerting, for example, to find (p. 5) Dr. A. A. Robb's theory of time and space referred to as a form of the theory of relativity. The misprint *Rolls'* for *Robb's* is perhaps pardonable carelessness, but the account of Einstein's principle of relativity is so slight and inadequate as to be positively misleading.

(4) "Thomas Sharnol" describes his adventure as "a popular study of the creative mind." It deals with the problem which is the most deeply interesting of all the problems of philosophy, yet the impression the reader is likely to derive is one of bewilderment in regard to the precise concept of "originality" he is invited to study. The book is an amazing pot-pourri of opinions, sentiments grave and gay, quotations from, and references to, writers of all sorts, past and present. The main philosophical motive which serves to hold the attention amidst the author's exuberance is the notion with which Bergson has familiarised us, that life is an impetus finding expression in the new forms it creates. Combined with this is the notion of the structure of unconscious mind which we owe to the discoveries of Freud and Jung. The book is very uneven, sinking at times to sheer triviality, yet pleasantly written and always good-humoured. It is intentionally addressed to the thoughtful man of general culture, and not to the student of technical philosophical problems.

H. W. C.

PHYSICS TEXT-BOOKS.

(1) *A Text-book of Physics for the Use of Students of Science and Engineering.* By J. Duncan and S. G. Starling. Pp. xxiii + 1081. (London: Macmillan and Co., Ltd., 1918.) Price 15*s.* net.

(2) *Advanced Text-book of Magnetism and Electricity.* By R. W. Hutchinson. Vol. i., *Magnetism and Electrostatics.* Pp. vii + 372 + Index xii. Vol. ii., *Electrodynamics.* Pp. vi + 468 + Index xii. (London: University Tutorial Press, Ltd., 1917.) Price, 2 vols., 8*s.* 6*d.*

(3) *Lecture Notes on Light.* By J. R. Eccles. Pp. vi + 217. (Cambridge: At the University Press, 1917.) Price 12*s.* 6*d.* net.

(4) *A Manual of Physics, Theoretical and Practical, for Medical Students.* By H. C. H. Candy. Second edition. Pp. viii + 451. (London: Cassell and Co., Ltd., 1918.) Price 7*s.* 6*d.* net.

(1) ENGINEERING students too often look upon physics as little more than a necessary evil, and a book that connects the scientific aspects of the subject with its modern practical applications fills a real need. The authors of this volume—one an engineer and the other a physicist—are to be congratulated on the successful way in which they have accomplished this task.

The book, which is both theoretical and practical, gives a course in dynamics, sound, light, heat, magnetism and electricity, which the authors claim is suitable for intermediate examinations. A student, however, who knew all in the book would be well beyond this stage. Few of the objectionable features of examination text-books occur, and the treatment is lucid and up-to-date. Modern high vacuum pumps, internal-combustion engines, periscopes, range-finders, kinemacolor, dynamos, X-rays, and radio-activity, are all considered. Strangely, there is no reference to wireless telegraphy, and some criticism might be offered of the treatment of Newton's "Laws of Motion." Minor details apart, however, the book is most satisfactory and should make a strong appeal to all engineering students.

(2) This is a text-book for final degree examinations, and it will probably appeal to the student who has but little outside assistance. The explanations are very full, and definitions and statements of special importance are printed in heavy type. There is a large collection of problems, taken chiefly from university examination papers, and some of these have been fully worked out. Brief directions for practical work are also given in the text.

The treatment mostly follows on stereotyped lines, but references to modern developments are interspersed, and the chapters on radio-activity, the passage of electricity through gases, and electronic theories are well written, and it is here difficult to find any of the more important developments of the subject that are left untouched.

(3) This book was originally written for the pupils of Gresham's School, Holt, and it probably forms a satisfactory supplement to the author's course of lessons; but it is nevertheless unlikely to make any general appeal.

The master is supposed to "lecture on the lines of the notes and draw the diagrams on the board," whilst the boys enter the diagrams in special copies of the book with blank left-hand pages. The present volume is intended as a guide to the master, and the diagrams—some very carefully drawn—are inserted. The wording throughout is somewhat loose, but in spite of this the author wishes his definitions to be "learnt by heart." On p. 117 the "edge of a prism" is defined! Further, we are told that, "since light travels in straight lines, any one of these straight lines is called a ray of light." The objection to the corpuscular theory is that, "if the corpuscles travelled with this immense velocity, they would possess considerable momentum, of which there is no evidence"; whilst, after three lines of explanation, the wave theory is dismissed as "the one that is now in vogue."

(4) Students working for the First Examination of the Conjoint Board, or even possibly for the London University First Medical, will find in this book most of the information they need. In addition to the ordinary theoretical work, about forty pages of the book are devoted to brief instructions for carrying out a number of illustrative experiments. The style is simple throughout, sometimes even at the expense of accuracy, and descriptions of out-of-date pieces of apparatus still occur. Nevertheless, those who have never studied physics before will find the book very useful. The present edition appears to be a

very considerable improvement on the first, and there are a number of references to the applications of physics to medicine that may help to bring home to the student the dependence of his future work on the more fundamental sciences.

G. D. W.

MEDICINE AND THE LAW.

Lyon's Medical Jurisprudence for India, with Illustrative Cases. By Lt.-Col. L. A. Waddell. Sixth edition. Pp. xiii+783. (Calcutta and Simla: Thacker, Spink, and Co.; London: W. Thacker and Co., 1918.) Price 28s. net.

THE reviewer remembers the appearance of the first edition of this work in 1888, for in that year he passed from military to civil employ under the Government of India and became a district civil surgeon. That officer, to a certain extent, combines the duties of police surgeon and coroner, since all medico-legal cases are submitted to him. Upon his report further action depends. Where the use of poisons is suspected he passes on the viscera or other material to the chemical examiner, whose report is attached to the surgeon's record. In the Presidency cities where there exist coroners' courts a special surgeon is appointed for medico-legal work. In Calcutta and Bombay that officer is also lecturer on medical jurisprudence in the medical college. The later editions controlled by Lt.-Col. Waddell have maintained the reputation which Lyon's work acquired at its first appearance. With advances in research and experience new tests and methods have been added, while old technique has been improved. Time brings few changes in fundamentals, but, as knowledge increases, science follows more closely the track of the criminal and provides more certain help to those who administer the law.

There can be no more profitable school for the student of forensic medicine than a large Indian city such as either Bombay or Calcutta. Lyon took his material from the police records of Bombay and from that classic storehouse of illustrative cases erected by Norman Chevers. As regards toxicology Lt.-Col. Waddell was specially fitted for the editorial work through practical knowledge acquired as a Government chemical examiner in Calcutta. It is again, in this new edition, from Bombay that much help has come. In the "Preface" Lt.-Col. Waddell records indebtedness to the experience of Prof. Arthur Powell, lecturer on medical jurisprudence at the Bombay University.

Very useful advice is given to the medical witness as to demeanour in court and as to the character of his replies to questions. This advice is amplified in the appendices, where examples are given of the kind of question which may be expected in particular cases.

Now that well-deserved praise has been given, is there anything lacking, anything that might be amended? While most of the chapters contain the latest information, it is noticeable that chap. xxvii., "Snake Venoms," gives no reference to the valuable recent researches of Acton and Knowles ("Ind. Jour. Med. Res.," 1914, pp. 46–148). This paper "throws the searchlight into many dark places, straightens some crooked ways, and is altogether illuminating and inspiring" (Alcock).

Again, one is surprised to find scorpions and spiders classed as "venomous insects" (p. 592). Errors which might be due to proof reader or printer are few and of no great importance. "Myer" for "Mayer" (pp. 623, 624) might lead to momentary difficulty, but the reagent is well known. The book has a good general index and also a "Vernacular Index of Plants and Drugs." We notice some differences in the spelling of certain names in the text and in the latter index. This may be due to different hands using slightly different methods of transliteration. As cases of self-inflicted injuries to support false charges are rare in England, it may be mentioned that the case of Jitan Ali Mir (ref. p. 573) was fully reported, under the title "Two Interesting Medico-legal Cases."

J. H. T. W.

OUR BOOKSHELF.

Department of Commerce, U.S. Coast and Geodetic Survey. Terrestrial Magnetism. United States Magnetic Tables and Magnetic Charts for 1915. By D. L. Hazard. Pp. 256+maps 5 in pocket. (Washington: Government Printing Office, 1917.)

THE latest American publication of similar scope referred to 1905, but declination charts for 1910 have been published. The observing stations used for the present charts exceeded in number those used for the 1905 charts by some 50 per cent. For declination 405 sea observations were used, and results from 6120 land stations, including 1129 in Canada, Mexico, and the West Indies. The first set of tables give declination (D), inclination (I), and horizontal force (H) results obtained at successive epochs at repeat stations. The D and I results are given to the nearest $1'$, the H results to the nearest 10γ. The second set of tables gives the corrections for reducing observations taken at different epochs and in different geographical positions to the epoch January 1, 1915. They are followed by tables giving D, I, and H, first as observed at the several stations, then as reduced to January 1, 1915. The last set of tables gives for each whole degree of latitude and longitude the values for January 1, 1915, of D, I, H, total force (T), and north, east, and vertical (V) components. Latitudes from 19° to 51° N. are included. At 19° N. the longitudes range from 74° to 105° W., while at 47° N. they range from 64° to 128° W. In these final tables the D and I results go to 0·1°, the force results to 0·001 C.G.S.

A pocket at the end of the volume contains charts of D, I, H, V, and T for the epoch January 1, 1915, the lines of equal values of the elements being in red. The first three charts include lines of equal annual change in blue. The extreme values of the annual change in D are met with on the Canadian border on the Atlantic coast, where westerly declination has an annual increase of 6′, and in the S.W. in Texas and California, where easterly declination has an annual increase of 3′. Inclination is increasing as much as 7′ a year in the extreme south of Florida, whereas in the extreme north, on both the Atlantic and Pacific shores, it shows an annual fall of 1′. H is falling throughout the whole of the United States, the annual decrease varying from 10γ in the extreme north to 120γ in the extreme south. The volume contains a great mass of magnetic information in a convenient form.

C. Chree.

Directions for a Practical Course in Chemical Physiology. By Prof. W. Cramer. Third edition. Pp. viii + 119. (London: Longmans, Green, and Co., 1917.) Price 3*s.* net.

"The text of this edition is (apart from a few verbal alterations) identical with that of the second edition. The changes in the external appearance of the book have been made with the object of keeping the price as far as possible at its former level." So runs the preface, and that being so, any extended notice of this book is unnecessary. The second edition was fully reviewed in Nature for March 25, 1915, and we then took occasion to point out what we conceived to be its defects. These defects still remain, but, in spite of them, the work has been a success, seeing that a new edition has been necessary after so short an interval.

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.]*

Reconstruction Problems and the Duty of Science.

It is sufficiently obvious that the problems of reconstruction following the war will tax the intelligence and good will of mankind to the utmost. It is also certain that mistakes made during this period will have more serious consequences than similar errors in a period of less social plasticity. By the same token, wise moves will produce greater and more permanent good. Never before, perhaps, has the obligation to choose between good and evil been quite so insistent, or the danger of a wrong choice quite so perilous.

Already we observe several groups of people preparing to deal with this situation. Their methods are diverse, and their aims more or less conflicting. Upton Sinclair sends us the first number of a new periodical, devoted to social justice. Yesterday I attended a meeting in which college students were invited to consider the ethics of Jesus as a foundation for the new democracy. The speaker spent some time in explaining to us that the movement, which is a national one, was neither pacifist nor pro-German. Business men, we read in the papers, are inviting the Germans to consider the conditions under which it will be possible to resume commercial relations. All these movements, and others, invite public discussion, and are beneficial to that extent at least. Underlying the Christian and Socialist propaganda is the entirely right feeling that mankind must agree on some system of ethics, some basic philosophy, which will make for co-operation and human welfare. It is possible that there is more than one such system which would fairly serve our purpose; but it is certain that we must, in the main, agree. The very existence of democracy implies some such agreement, and its failures result from the partial lack of it.

So far, I think scientific men can reasonably, indeed enthusiastically, go with the religious and radical groups. We are all seeking an absolutely necessary basis for conduct. Yet at this point, where we seem unanimous, grave possibilities of conflict arise. The scientific man is obliged to ask: What will be the consequences of the doctrines we propose to adopt, and how will they harmonise with natural law? There was a time when it was generally agreed that illness was due to evil spirits, and in a certain sense the facts were as postulated. Yet the total ignorance of the nature of those "spirits," of bacteria, left man in a very defenceless position. Nature penalised him, and she always does, for his ignorance, not asking whether he "ought" to have known. So it must always be, and *mere* good intentions or pious motives, without wisdom, avail us nothing. They may avail less than nothing if they create an impression that our problems have been met, when they have only been evaded. This is clearly seen by the ablest representatives of most movements, but not so clearly by a large portion of the rank and file. It is because it is so easy to allow emotion to crowd out intellect, and then to lead it to waste its energies in uninformed sentimentalism, that unpatriotic motives have sometimes been ascribed to those whose love of their country and their fellows was actually keener than ordinary. Such injustice is naturally resented; but it remains a fact that there are many who for various reasons are particularly interested in preventing the great volume of hope and good will from turning the wheels of reform. To such all ineffective efforts afford "aid and comfort."

While the scientific fraternity, thus confronted with a perplexing situation, is making up its mind how to act, what may be considered a perfect manifesto on its behalf has come from an unexpected source. The *New Republic* of February 16 prints the report on reconstruction by the Sub-committee of the British Labour Party. The concluding passage of that report reads as follows:—

"The Labour Party is far from assuming that it possesses a key to open all locks, or that any policy which it can formulate will solve all the problems that beset us. But we deem it important to ourselves, as well as to those who may, on one hand, wish to join the party, or, on the other, to take up arms against it, to make quite clear and definite our aim and purpose. The Labour Party wants that aim and purpose, as set forth in the preceding pages, with all its might. It calls for more warmth in politics, for much less apathetic acquiescence in the miseries that exist, for none of the cynicism that saps the life of leisure. On the other hand, the Labour Party has no belief in any of the problems of the world being solved by good will alone. Good will without knowledge is warmth without light. Especially in all the complexities of politics, in the still undeveloped science of society, the Labour Party stands for increased study, for the scientific investigation of each succeeding problem, for the deliberate organisation of research, and for a much more rapid dissemination among the whole people of all the science that exists. And it is perhaps specially the Labour Party that has the duty of placing this advancement of science in the forefront of its political programme. What the Labour Party stands for in all fields of life is, essentially, democratic co-operation; and co-operation involves a common purpose which can be agreed to; a common plan which can be explained and discussed, and such a measure of success in the adaptation of means to ends as will ensure a common satisfaction. An autocratic sultan may govern without science if his whim is law. A plutocratic party may choose to ignore science, if it is heedless whether its pretended solutions of social problems that may win political triumphs ultimately succeed or fail. But no Labour Party can hope to maintain its position unless its proposals are, in fact, the outcome of the best political science of its time; or to fulfil its purpose unless that science is continually wresting new fields from human ignorance. Hence, although the purpose of the Labour Party must, by the law of its being, remain for all time unchanged, its policy and its programme will, we hope, undergo a perpetual development, as knowledge grows, and as new phases of the social problem present themselves, in a continually finer adjustment of our measures to our ends. If law is the mother of freedom, science, to the Labour Party, must be the parent of law."

In this spirit all students of science may unite. Through it, and not otherwise, may the decay of civilisation be arrested, and the fair fruits of ages of effort brought to maturity. T. D. A. Cockerell.

Boulder, Colorado, March, 1918.

The Motion of the Perihelion of Mercury.

The type of resistance suggested by Sir Oliver Lodge (Nature, April 18, p. 125) is very difficult to visualise. The motion of a planet consists practically of a steady motion in a circle, with a superimposed free vibration, the amplitude of which is proportional to the eccentricity, and the phase of which depends on the longitude of the perihelion. The hypothesis that the perihelion can be made to move without alteration in the eccentricity is equivalent to assuming that a free vibration can persist in a resisting medium without change of amplitude. It is true that the absolute resistance would be expected to be greater at perihelion than at aphelion, on account of the difference in density at the two points, but this difference contains the eccentricity as a factor, and it is for this reason that the rate of decrease of the eccentricity and the motion of the perihelion would be of the same order of magnitude.

The limitation of the resistance to a force parallel to the minor axis would mean that the departure of the orbit from circularity determines a very small part of the resistance, most of this being due to a general motion of the medium in that direction with a velocity far exceeding the parabolic velocity. Even without the difficulties introduced by the high density required, such a velocity could not be accepted.

One effect of a difference between longitudinal and transverse electromagnetic masses was shown by Mr. G. W. Walker, in the April *Philosophical Magazine*, to be a change in the plane of a planet's orbit. The nature of this change can be found without much difficulty to be a rotation of the plane about the projection on itself of the sun's motion in space, the speed of rotation being proportional to the product of the components of the sun's motion in and perpendicular to the plane. The rotation being about an axis in the plane of the orbit, the effect on the nodes should be much less than that on the inclinations, whereas the contrary is the case. Thus it seems that the motion of the node of Venus cannot be accounted for in this way, and either one of the two component velocities must be very small or the effect of absolute motion on electromagnetic mass must be in some way compensated in the law of gravitation itself. The absence of the variations in the eccentricities that would be expected to be produced by a motion of the sun through space also suggests that there is such a compensation. Harold Jeffreys.

A Plea for the Naturalist.

The naturalist is not so black as he is painted. Conditions of modern technological inquiry are against him; the splitting of species into geographical and local races, distinguished by the finest touches of colour or the minutest of structures, has put the detailed identification of many of our native creatures beyond his compass.

But there is still a wide field for the naturalist, the closer observation of the habits of our native creatures. It is to be regretted, therefore, that in this his proper field his work should be slighted and minimised by the worker who prides himself, and rightly, on his technical equipment for specialised work. In a recent issue of Nature (March 21) a writer grouped naturalists with "landowners, sportsmen, farmers, rat-catchers," as well as a large class of bird-lovers, as being of the people whose personal opinion "is really of very little moment," in a matter which, after all, is mainly one of observation—an inquiry into the economic significance of the feeding habits of birds.

Why the fact that a man possesses or farms a few acres should invalidate his natural history observations is not easily understood. And, after all, are the opinions of the naturalist really so much at fault? Many times during the last few years we have been told in effect that years of careful work by an experienced investigator, supplemented by the researches of many others, had at last made it "possible to state definitely that at the present time there is ample evidence of a far-reaching kind to prove that no quarter should be shown to the wood-pigeon," that the rook "is far too plentiful at the present time, that it prefers a grain diet, and that it is injurious," that "the starling has increased in numbers enormously," and that "the bullfinch and blackbird in fruit-growing districts are most destructive."

But the naturalist knew and had recorded these things; pigeon-shoots are not affairs of yesterday; and already in the early part of the fifteenth century the Scottish Parliament had passed a law for the destruction of rooks precisely on account of their "gret skaithe apone cornis." On the whole, the naturalists and farmers were right, and minute researches have confirmed their general opinions.

On the whole, too, the results of the minute researches are less definite than would at first sight appear, for, apart from the difficulty of contrasting vegetable with animal food as it is represented in the food canal of a bird some time dead, there is the danger of reaching conclusions from unconsciously selected specimens. The gull on the turnip-field is likely to be shot and sent for examination, that on the offal of the fishing village is likely to be left unharmed, and the percentage of injury caused by gulls rises accordingly. No one would dream of deprecating such inquiries as have been carried on. They are necessary and of the greatest value, and in the hands of an organised group of observant workers of wide sympathies they will yield a large proportion of truth. But they are not infallible.

The contributions of both naturalist and laboratory expert are necessary to the fullness of this knowledge, but one without the other leans on a broken reed.

April 11. James Ritchie.

TIME AT SEA AND THE ASTRONOMICAL DAY.

In spite of the stress of war, the British, French, and Italian Admiralties found opportunity last year to come to an important decision on the question of timekeeping at sea. Hitherto the general practice appears to have been to set the ship's clocks to the local time corresponding with the place where observations were made, and continue its use until further observations were secured. In consequence, two vessels speaking each other might record different times for their meeting; cases are not unknown where it has been of legal importance to ascertain the exact time of a death occurring at sea, which was a matter of some difficulty on the old system. It has now been resolved to extend to the sea the

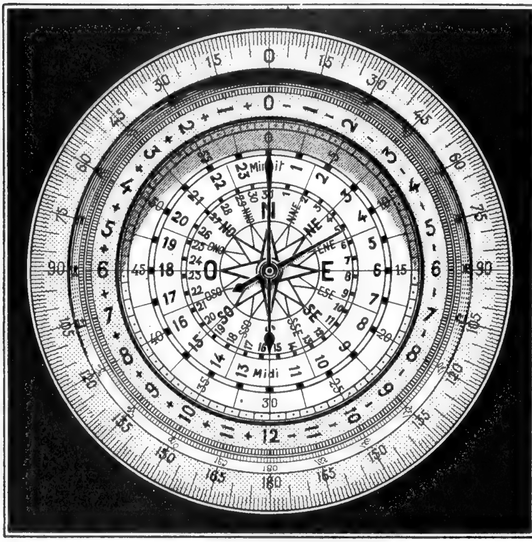


Fig. 1.—P. Vincent's design for chronometer dials.

system which has been so widely adopted on land, of keeping time which differs by an integral number of hours from Greenwich time, the hour being changed on crossing meridians 15° apart. In this connection it may be noted that there is need of a short name for the regions that keep the same time. The word "zone" is to be deprecated, since both by root-meaning and by usage it suggests a belt parallel to the equator. The word "lune" has been adopted in works on spherical trigonometry, but is apt to suggest a connection with the moon. The French use the somewhat cumbersome term "fuseau horaire." Mr. T. C. Hudson suggests the term "douve"; it means a barrel-stave, which has some resemblance to the shape of the regions in question.

Commandant P. Vincent has devised a new form of chronometer dial to facilitate the determination of the ship's time; he describes and illustrates it in *La Nature* for March 2 (see Fig. 1). There are three hands, indicating day of month, Greenwich hour, and minute respectively. Apart from the month hand, which is of the nature of a luxury, the new form of dial could be readily adopted for all chronometers. It has five concentric circles of graduation: first, the degrees of longitude, counted from 0° to 180° in each direction; second, the hours to be added or subtracted; third, the graduations of the minutes of time; fourth, the Greenwich hours, reckoned from 0h. (midnight) to 23h.; fifth, the days of the month; inside these the compass points are indicated, but they can be omitted if desired.

The discussion on time at sea has incidentally reopened a larger question, which was mooted some thirty years ago, but shelved for a time. This is whether the use of the astronomical day, commencing at noon, might not be discontinued, and the civil day, commencing at midnight, extended to astronomy. This matter has been under informal discussion for several months, and in the opinion of the present writer the general feeling is in favour of the change, though there are some names of great weight on the other side. The astronomical day goes back at least to the time of Ptolemy; it is based on the obvious principle that the bulk of observational work is done at night, so that the night should be kept as an unbroken unit. But this point is not gained without appreciable inconveniences; most astronomers must have felt a considerable amount of mental worry in having a different calendar date for all occurrences between midnight and noon, according as we are considering their astronomical or their civil aspect; even the month or year is sometimes affected. There is, moreover, some confusion as to whether the astronomical day begins with mean or apparent noon; the Nautical Almanac uses both systems in different sections, so that several minutes each day form a sort of No-man's-land, being claimed for different dates on different pages of the almanac; there would be no similar confusion at midnight, apparent midnight being a meaningless phrase.

Both the British and French Admiralties are agreed that the use of the civil day would be a convenience to navigators. The French have already decided to adopt the civil day in their abridged Seamen's Almanac from the year 1920. A few British astronomers have suggested that our abridged almanac should be changed, but not the larger one. This would lead to great risk of error, since the larger almanac is often used at sea; the sailor has a claim to consideration before the professional astronomer, since the latter has more leisure to make his calculations, and errors, if made, are less disastrous.

In response to an appeal from the Admiralty, the Royal Astronomical Society is now sending round a circular to representative astronomers and societies in our own, the Allied, and neutral countries. This, after a brief *résumé* of the circumstances, enumerates the changes in the almanac that would be involved if the new system were adopted, and invites suggestions and criticism. It is thought that 1925 is the earliest date that is practicable for making the change, since the almanac goes to press several years in advance. It is proposed that the reckoning by Julian days shall still begin at Greenwich noon, in consequence of the numerous ephemerides of variable stars that have been drawn up on this system; this would afford a means of relief to those astronomers who dislike the change; by dating their observations in Julian days, instead of calendar dates, they could continue to keep their nights undivided.

It is hoped that the change, if made, will be adopted throughout the astronomical world, so that an interval is wisely being left for full ventilation of the subject. Some have hopes that the change might be accompanied by the introduction of twenty-four-hour reckoning by the general public; this system has long been in use in Italy, and leads to a great simplification of time-tables of railways, tides, etc. It does not necessarily involve the use of new clocks with twenty-four-hour dials. It suffices to use the present dials, merely inserting 13h. to oh. inside the figures 1h. to 12h. In fact, many prefer this system, since the hours on a twenty-four-hour dial are inconveniently close.

A. C. D. CROMMELIN.

THE RECOVERY OF POTASH FROM BLAST-FURNACE GASES.

THE sources of potash were described by Sir Edward Thorpe in an article in NATURE of January 3 (p. 344). One of these sources has been the subject of study by Prof. R. A. Berry and Mr. D. W. McArthur, who have published the results of their investigations in a paper read before, and discussed at, a meeting of the West of Scotland Iron and Steel Institute. These investigators have studied in particular the possibilities of recovering potash from the blast-furnace gases obtained in Scottish practice, with the view of obtaining information as to how far these may be expected to constitute an economic source of supply, when the restrictions imposed by the war no longer hold.

That the dust deposited from blast-furnace and kiln gases contains potash salts has long been known, and in 1884 Barclay and Simpson, of the Harrington Ironworks, Cumberland, took out a patent for the recovery of salts, and especially potash salts, from coke-fed furnaces. The most considerable investigation, however, on this subject is that by Wysor, of the Bethlehem Steel Company, U.S.A., who found that the dust which collected at the bottom of the stone chequer-work in the stoves and gas-fired boilers contained 15 per cent. of water-soluble potash (K_2O). Further, he drew up a balance sheet to show the amount of potash charged into the furnace and the percentage recovered. His conclusion was that the greatest losses occurred in the primary and secondary washers, constituting some 56 per cent. of the whole, while 20 per cent. was carried off in the slag; further, that less than 1 per cent. of the potash charged was recovered in the dust alluded to. In 1916 a Cottrell plant for electrostatic precipitation was installed, and it was found that practically all the dust could be precipitated. About 22·4 lb. of potash were charged per ton of pig-iron produced, and after deducting the amount contained in the slag and the dust-catcher, about 15 lb. per ton of pig-iron appeared to be left in the gases, which were then recoverable in the Cottrell plant.

The average potash content of the American ores is about 1 per cent., and as the production of iron in the United States in 1916 was nearly forty million tons, if Wysor's figures are correct the flue-dust from the furnaces should constitute a very considerable source of supply.

As the authors point out, the problem in Scotland is different: first, because coal, and not coke, is the fuel generally used, and secondly, because the ores contain rather less potash. With coke-fired furnaces the gases are not washed, but are led from the catchers direct to the stoves and boilers. In coal-fired furnaces, however, a considerable amount of tarry matter is produced, whereas the dust deposited is relatively very small. The problem of recovery is therefore different. The potassium is present in the ore, principally, no doubt, in the form of silicate. This reacts at the high temperature of the furnace and forms other compounds, for, as the dust analyses show, chlorides, sulphates, and carbonates were the principal acid radicals present. It is well known, further, that potassium cyanide is formed in certain regions of the furnace, but decomposed in others. At the high temperature these potassium salts are vaporised; they condense in the cooler parts of the furnace as fine dust particles, and are carried along with the dust from the fuel and the ores. The first particles deposited are the heaviest, and these are caught in the dust-catcher, in the form of a coarse, black powder; deposition also occurs on the main tube, and these two constitute the tube cleanings. The heavy, tarry matter separates principally in the condensers and carries with it much of the fine dust; the gas then passes to the water scrubbers, which retain the rest of the tarry matter and most of the remaining dust. Any mineral matter still retained is caught in the stove and boilers.

The authors have received and analysed samples of these deposits and liquors from various plants in Scotland, and have determined their potash content. Nine samples of flue-dusts were examined: eight from coal-fired furnaces and one from a coke-fired furnace. The highest yield of dust in the former was only at the rate of 21 tons per annum, as against 300 tons for the latter, and the water-soluble potash averaged 8·86 per cent. The percentage of ash in the tube cleanings varied from 53 to 74 per cent., but these contained a very small percentage of water-soluble potash, the highest being 2·7 per cent. Special attention was paid to the spent liquor, of which the specific gravity, total solids, ash, and water-soluble potash were determined; and the authors discuss various methods of separating the mineral values from the tarry matter, which greatly hinders evaporation.

In the case of one firm the authors have drawn up a balance sheet showing the amounts of potash in the raw materials charged, and its distribution in the products. In one case where 7·6 lb. were charged per ton of pig-iron, 6·04 lb. per ton were accounted for, of which 1·4 lb. were contained in the spent liquor, 1·7 lb. in the pitch, 0·2 lb. in the tube cleanings, 0·04 lb. in the flue- and stove-dust, and 2·7 lb. in the slag, leaving 1·6 lb. unaccounted for. This balance sheet is very different from that obtained by Wysor, but too much stress should not be laid upon it, because the figures refer to one plant only. The authors estimate finally that about 1667 tons of water-soluble potash are recoverable per annum from the 102 Scotch furnaces. They give, however, no estimate of the total amount of insoluble potash, and refer only briefly to the possibility of its being rendered soluble. It does not look as though the prospect of recovering potash profitably in Scotland after the war was at all promising, and this view was emphasised in the discussion which followed.

H. C. H. C.

WAR-TIME RESEARCH IN THE UNITED STATES.

It is difficult to find in this country in these days a scientific worker, however recondite his studies may have been in pre-war days, who is not engaged in problems connected with the war, the development of industry, or the extension of trade. A similar state of things, at an earlier stage, is to be seen in the United States, where the National Academy of Sciences has formed a National Research Council, which is organising research on current problems. The council is nothing if not catholic in its ideas of war-time research, and the subjects allocated to its committees and sub-committees range from palæontology to psychology.

The council has apparently been much concerned to secure for American libraries and scientific institutions supplies of German scientific literature, held up in Amsterdam and London as a result of the British blockade. The difficulty has been satisfactorily solved, and official forms have been duly evolved for the liberation of consignments, certified by the Library of Congress in Washington and the United States Consul in London.

The Geology and Palæontology Committee of the council has published a brochure entitled "What a Geologist can do in War." This has been freely distributed among Army officers, with the view of explaining what service they can expect from geologists. The same committee is collecting information as to the materials available in the coastal States for the construction of roads and fortifications.

In association with other organisations the Committee on War Minerals has made a census of all minerals required for war purposes, with notes on their production, stocks held in the United States, sources of supply, and other matters. Special surveys have been undertaken in some cases to complete information regarding minerals and to secure data necessary to permit of the rapid exploitation of deposits. Dr. Dean, curator of the Department of Arms and Armour in the Metropolitan Museum and of Fossil Fishes in the American Museum, and a member of this committee, has designed models for modern body armour, which are now being made for trial in field operations.

The Committee on Zoology has organised an extensive field of work in connection with the elimination and control of animal pests, especially those known to be carriers of disease, the examination of pathological specimens, investigation of water and soils from camp-sites, and the disposal of garbage and drainage. Even more important, perhaps, in view of the urgency of the food problems caused by the war, is the work this committee intends to undertake on the improvement of breeds of domestic animals, better methods of increasing and conserving stock, and possible remedial measures against food-destroying insects. Another interesting problem in its programme is the study of limbs and joints with the view of improving the construction of artificial limbs. The utilisation of aquatic birds in locating submarines, a subject which has not escaped the attention of the popular Press in this country, is also being considered.

The programme of the Botanical Raw Products Committee is perhaps the most far-reaching of all, since it aims at establishing for the use of manufacturers a kind of "clearing house of information" regarding raw materials, exclusive of food staples. This committee proposes to collect all available information regarding plants of economic value with the view, among other things, of producing supplies of essential raw materials at home, providing substitutes for materials previously imported, and investigating the possibilities of new raw materials. This committee points out that "often a great industry buys its raw material from a broker or an importing house without knowledge of either the geographic or the specific source. When this source is cut off, as has frequently been the case during the past three years, and as possibly will be more frequent during the next few years, the manufacturer has been placed in an uncomfortable position. Curiously enough, such a predicament is many times brought about by the curtailment of a product used in such relatively small quantities that the fact that it is essential to the finished article is overlooked or forgotten during times of plenty." This opinion is worth quoting, as it diagnoses accurately a predicament in which many a manufacturer in the belligerent countries has found himself during the war with regard to both raw materials and partly manufactured products.

Numerous other committees have been formed, but the foregoing notes will be sufficient to indicate the far-reaching scope of the National Council's activities and the practical character of the work it proposes to undertake. Throughout the programmes of work laid down, but especially in that of the Botanical Raw Products Committee, it is interesting to note that the problems to be solved are of immediate practical importance, and that close co-operation with traders and manufacturers in solving them is considered essential.

T. A. H.

NOTES.

The British Science Guild is organising a comprehensive British Scientific Products Exhibition, to be held at King's College, London, for four weeks during the coming summer. The exhibition will comprise a large display of products and appliances of scientific and industrial interest which prior to the war were obtained chiefly from enemy countries, but are now produced in the United Kingdom. Much has been accomplished by our manufacturers since the opening of the war in industries in which previously we had been falling behind, and it is believed that the exhibition will have a stimulating influence upon scientific and industrial research by bringing home to the public the supreme importance of science in industry. Particulars of the exhibition will be issued shortly.

According to Press reports, platinum has been discovered in some quartz deposits in the Ober Rosbach district of the Taunus Mountains (Germany). Steps have already been taken to work the deposits.

The death of Mr. Daniel Macalister on April 12 is announced in *Engineering* for April 19. Mr. Macalister was the engineer and superintendent of the Greenock Corporation Water Department, and had also acted as the resident engineer during the construction of the James Watt Dock. He joined the Institution of Civil Engineers in 1882, and held the institution's Miller prize.

We regret to record the death of Mr. Richard B. Prosser, which occurred on March 26. Mr. Prosser was born in Birmingham in 1838, and was regarded as one of our best authorities on the history of invention. He was connected for about twenty years with the Patent Office Library, and became superintendent examiner of specifications in 1883. An account of his career appears in *Engineering* for April 19.

By way of supplement to the leaflet entitled, "Birds, Insects, and Crops," the Royal Society for the Protection of Birds (23 Queen Anne's Gate, S.W.1) has issued a series of twelve "Bird-Ally" postcards, each bearing on the front a quotation as to the value of birds on the land, while the back is left free for writing. The postcards, which can be had for 4½*d.* a packet, should be useful at the present time, when the Board of Agriculture has warned growers of probable insect plagues.

The death is announced, in his eighty-sixth year, of Mr. E. T. Wilson, a well-known medical man, of Cheltenham. In 1901 Mr. Wilson was the president of the Medical Section when the British Medical Association met at Cheltenham. He contributed numerous papers to the medical periodicals, and was the author of "Sanitary Statistics of Cheltenham." He founded a naturalists' society at Cheltenham, and was interested in the collection of Neolithic flint implements. His son, Dr. E. A. Wilson, was a member of Captain Scott's Antarctic Expedition, and died on the journey from the South Pole.

The subject of the Jacksonian prize of the Royal College of Surgeons of England for 1919 is to be "The Investigation and Treatment of Injuries of the Thorax received in War." The John Tomes prize of the college for the period 1915 to 1917 has been awarded to Mr. J. G. Turner for his work on the subject of dental pathology. In consequence of the temporary removal of the pathological specimens of the museum of the college for greater safety, the delivery of the Erasmus Wilson lectures, and the demonstrations, are to be discontinued for the duration of the war.

By the death, at the age of seventy-seven, of Col. George Adolphus Jacob, India has lost an accomplished scholar. Belonging to a well-known Anglo-Indian family, which included the famous founder of Jacob's Horse, he entered the Indian service at the age of sixteen in the Bombay Presidency, where he mastered the Marathi language, and later on devoted himself to the study of Sanskrit. His chief work was done in philosophical literature—a monumental concordance to the principal Upanishads and the Bhagavad Gita, and his manual of Indian Pantheism, the best introduction to the Vedanta. His official work was the Directorship of Military Education, and he acted as examiner in Sanskrit and Marathi for the University of Bombay. The University of Cambridge conferred on this eminent scholar the honorary degree of Litt.D.

In the *Nieuwe Courant* Dr. I. P. Lotsy recently directed attention to the hybridisation experiments of Mr. R. Houwink, a private breeder of Meppel, Holland, who has tested Darwin's view that our domestic fowls are derived from *Gallus bankhiva*. He has obtained fertile hybrids of this species with *G. Sonnerati*, and also with *G. furcatus*. The latter hybrid was again fertile with *G. bankhiva*, whence it would appear that all three species may be among the ancestors of domestic breeds. Domesticated rabbits have been found fertile both with wild rabbits and with hares, and hybridisation experiments are also in progress with jackals, foxes, and wolves, in order to determine the origin of domestic breeds of dogs. Experiments on the crossing of wild and domesticated pigs are subsidised by the Dutch Government.

The *Times* of April 19 and 20 contained letters by Mr. W. Baden-Powell and Mr. R. B. Marston directing attention to the Order about to be made by the Board of Agriculture and Fisheries authorising the taking of salmon kelts, subject to certain conditions. It is suggested by both correspondents that an excellent opportunity is thus afforded for obtaining evidence with regard to the rather obscure questions whether and to what extent kelts feed in fresh water, and also whether they destroy the young of their own species. Many anglers would probably be glad to take out the stomachs and digestive organs of the fish they kill and send these, with full particulars, to scientific men appointed by the Board. Hitherto it has been illegal to take kelts, and so the evidence with regard to their feeding habits is very unsatisfactory and meagre. Mr. W. J. M. Menzies, in the

Times of April 23, states that he has examined a certain number of kelts in all the so-called "mending" stages, and has found no trace of food in any of them.

Hull is probably one of the few places in this country which are extending their museums in these times. It may be remembered that during the Museums Conference at Hull in 1913, Col. G. H. Clarke purchased for 1000*l.* the Mortimer collection of Yorkshire archæological and geological specimens, which the members had an opportunity of visiting at Driffield, and as the building is now required for other purposes the collections have been removed. The Hull Corporation has taken some temporary premises in Albion Street, in the centre of the city, and in these the entire collection has recently been placed, and steps have been taken to prepare the museum for public inspection. When it is remembered that in the archæological collection alone there are the entire contents of nearly four hundred barrows of the Bronze age, as well as several hundred skulls of prehistoric, Roman, and Saxon date, about 1000 prehistoric, Roman, Saxon, and medieval vases, some of large size, and the contents of several Anglo-Saxon and Roman cemeteries, it will be understood that the removal of the collection has been an undertaking of some magnitude. Nearly twenty vanloads were required to remove the specimens, and we understand the entire collection, consisting of about 60,000 objects, has reached its new quarters without damage.

It is proposed shortly to establish in Naples a National Experimental Station for Ceramics and Glass-making, in which will be incorporated the existing Ceramic Laboratory of the Royal Museum for Industrial Arts at Naples. *L'Economista d'Italia* for April 4 states the objects of the new institution as follows:—(1) To carry out researches bearing on problems connected with ceramics and glass-making, and to promote such manufacture by publications, lectures, and assistance; (2) to experiment with and publish new methods of working, for the better utilisation of raw materials, the improvement of the quality of the products, and the effective utilisation of by-products and waste; (3) to investigate and suggest new sources of supply of raw materials and new markets for the products; (4) to give opinions and advice; (5) to make analyses, tests, and researches, and to verify instruments and apparatus when requested by the public, by manufacturers, or by public bodies; (6) to provide laboratory accommodation, etc., for the use of students; (7) to publish a bulletin giving results of researches and other information; (8) to admit into the laboratories as pupils young students who have passed through a technical college and taken a diploma, etc., and intend taking up the manufactures mentioned; further, to hold evening and holiday classes of theoretical and practical instruction for work-people.

An account of an interview with Prof. E. H. Starling on the position of natural science in the educational system of Great Britain, as described in the report to which we directed attention last week, is given in the issue of the *Observer* for April 21. The report, Prof. Starling remarked, is an anticipation of and preparation for nothing short of a revolution in the intellectual life of the country. Hitherto in this country we have neglected and despised science. We have not understood that it is simply the whole of human experience ordered and classified. A State which tries to govern its affairs without science is blind. Every step it takes is a step into unexplored ground, and it only learns by bitter experience, by tumbling into every shell-hole it comes across. That is what we call "muddling through"—a method of which some people are proud. The question of the future is whether our democracy has learned the bitter lesson that the war has taught us—that for survival it must use the laws given by science, or go under. The penalty of sin is death. And sin in this case is a neglect of Nature's laws. One of the main points of the report is that it is necessary not only to make scientific experts, but also to educate every individual in this country so that he may know of the existence of this mass of human experience, and may recognise that behind every problem with which he is confronted there is the great body of science to which he can appeal for a right solution to his difficulties.

Mr. L. Andrews read an interesting and suggestive paper to the Institution of Electrical Engineers on April 18 on the "Overseas Distribution of Engineering Appliances." It is generally admitted that the British artisan as an engineering craftsman can hold his own against all competitors. He attributes, therefore, the commercial success of Germany and America in the pre-war days to the excellence of their systems of distribution. The British manufacturer is in too many cases content to make machines and apparatus and trust to his agents abroad to get the orders, leaving the conveyance of the goods to an outsider. This lack of co-ordination leads to unnecessary expense. To remedy this, Mr. Andrews proposes a modified form of State control. Some system of overseas trade service should be set up and managed by the State or by the State and private enterprise combined. Its first aim would be to provide facilities for British subjects in all parts of the world to secure British-made engineering appliances on satisfactory terms, and its second aim would be to give to British producers the fullest information regarding overseas requirements. Mr. Andrews instanced the Government Postal Service as the kind of department he advocated: it is run on strictly business lines, being financially self-supporting, and yet it competes with no private undertaking. He objected strongly to any despotic mandatory control by the State.

News of the death of Dr. Ethel de Fraine, Fellow of the Linnean Society, for some years lecturer in botany at Whitelands Training College, and afterwards lecturer in botany at Westfield College, University of London, has been received with great regret by many friends. Dr. de Fraine was a conscientious worker in the field of plant anatomy, particularly in the realm of seedling anatomy, a branch which has acquired great prominence of recent years. The series on the Gymnosperms, in which she collaborated with Mr. T. G. Hill, adds considerably to our knowledge of the obscure "transition" phenomena between the vascular structure of the stem and that of the primary root, and a similar independent contribution published in 1910 deals with the seedling structure of Cactaceæ. The School of Seedling Anatomy, to which these publications belong, was initiated by the work of the late Miss E. Sargant, and arose at the beginning of the present century as a modern development of that search for phylogenetic clues, that hunt for the "missing link," which is attributable to the spread of evolutionary ideas following upon the publications of Darwin. Dr. de Fraine, fixing her attention on taxonomic rather than on broad phylogenetic characters, was led to conclude that the study of seedlings was barren from this point of view. Her research career covered a period of about ten years, during which she made an incursion into the realm of fossil botany with a paper entitled "The Structure and Affinities of Sutcliffia." The ecological expeditions in which she took part resulted in 1913 in a treatise on the anatomy of Salicornia, the common seaside glasswort, and her last publication, in 1916, was on the morphology and anatomy of the genus Statice, as studied from its habitat at Blakeney Point. Dr. de Fraine belonged to a type of painstaking worker whose thoroughness of hand and spirit the world of science can ill afford to lose, and it is greatly to be feared that her faithful pursuit of knowledge, coupled as it was with a strenuous professional life, conspired to rob us of the further fruit of her labours. She died at Falmouth on March 25, after an illness of two years.

The Rev. H. G. O. Kendall, in the April issue of *Man*, reports the discovery at East Farm, Winterbourne Monkton, North Wilts, of a fragment of a fine, laminated, micaceous sandstone, very similar to the so-called altar stone at Stonehenge. This has been chipped into shape all round its periphery, so as to produce sharp-cutting edges and to form a knife, apparently of the Bronze age, resembling a small broad-bladed bronze dagger.

Dr. A. M. Meerwarth, assistant-curator of the Ethnographical Museum, Petrograd, recently visited India, and has compiled a useful "Guide to the Collection of Musical Instruments in the Indian Museum, Calcutta." A large proportion of the specimens were presented by the late Raja Sir Sourindro Mohun Tagore, the well-known authority on Indian music. The instruments, except a few of Tibetan origin, are almost exclusively from India or Burma. The guide is carefully prepared and gives much useful information on Indian music. In all 284 specimens are illustrated and described.

The dialects composing the Salinan Indian linguistic group, of which two survive in the Missions of San Antonio and San Miguel, are described in a monograph by Mr. J. Aldem Mason, published in vol. xiv., No. 1, of the Publications of the University of California on American Archæology and Ethnology. Recently Drs. Dixon and Kroeber have connected Salinan with Chumash in an "Iskoman" group, which, in turn, they have later come to regard as part of the Hohan family, a reclassification now accepted by several American philologists and anthropologists. Mr. Mason's monograph gives full linguistic details, and he prints a number of beast folk-tales in the original text with an English translation.

An interesting study of dosage in radium therapy by Mr. J. C. Mottram and Dr. S. Russ is given in the March issue of the *Archives of Radiology and Electrotherapy* (No. 212). Small subcutaneous cancerous nodules were treated, and among other results it was found that there is much less effect upon the skin (inflammation, loss of hair, etc.) when it is exposed for a long time to a weak source of radium emanations than when a strong source is used for a short time, the effect upon the cancerous growths being very nearly the same in the two cases.

The Journal of the Royal Microscopical Society for March (1918, part i.) contains an account, by Mr. R. Paulson, of microscopical and biological work carried out at the civilian internment camp at Ruhleben, near Berlin. The equipment of the laboratory consists of ten microscopes with accessories, a microtome, incubators, etc. Dr. A. E. Lechmere has given a course on elementary biology, Mr. M. S. Pease one on heredity, Mr. S. R. Edge has lectured on animal physiology, and Mr. A. Hill has given instruction on the testing of agricultural seeds. Various friends have presented material. A library of 500 volumes has been got together. At present Nature is the only periodical and link with scientific activity outside.

A disease known as "trench fever" has been very frequent among the troops on the Western front. It is characterised by recurrent attacks of fever of short duration, usually at intervals of four or five days, and followed generally by acute pain in the shins and frequently by dilatation and disordered action of the heart. A committee under the chairmanship of Surg.-Gen. Sir David Bruce was instituted to investigate the causation and spread of the disease. As regards the latter, various circumstances implicated the louse, and experiments were made on this hypothesis. Lice were allowed to feed on patients in all stages of the disease, and were then allowed to bite healthy volunteers; the result was negative. Next the excreta of lice similarly infected were applied to a scarified area of skin, and in from six to ten days after, all the five volunteers so treated developed trench fever. From these experiments it is evident that the bite alone of the louse does not produce trench fever, but that when the excreta of infected lice are scratched into the skin the disease is produced. The funds for this research have been provided by the Lister Institute of Preventive Medicine, and details of the research are published in the *British Medical Journal* for March 23 (p. 354).

Present-day applications of experimental psychology were dealt with recently in two lectures delivered at the Royal Institution by Lt.-Col. C. S. Myers. The first lecture was mainly on the application of psychological experiment to industrial efficiency. Laboratory researches on mental and muscular work were described, showing the relation between rest and length of task, the importance of determining and employing the optimal load, and the various psychological factors which affect the work curve. The economical value was emphasised of introducing systematic rest pauses in the workshops and of selecting by appropriate tests employés fitted for tasks demanding special skill. There is a wide difference between the increased production due to the adoption of scientific short-hand methods of industrial efficiency and that due to the more dangerous process of "speeding up." In the second of his lectures Lt.-Col. Myers devoted himself mainly to the subject of nervous breakdown, pointing out the extreme importance of early and proper treatment of the disorder in industrial as well as in Army life. He showed how the enormous importance now attached by psychology to the influence of the feelings had come to revolutionise our conceptions of memory, of personality, and of consciousness generally; and he insisted on the necessity for continuing in peace time the special hospitals and the special psychological training of doctors which it had been found necessary to organise owing to the effects of war-strain.

The Transactions of the London Natural History Society for 1916, which has just been issued, contains a long address on "Apterousness in Lepidoptera," by Dr. T. A. Chapman, which is of remarkable interest. Not only has Dr. Chapman summarised all that has been recorded on this theme, but he has also added many new facts gleaned from a long study of this subject. He is of opinion that the apterousness of the summer moths is due to factors entirely different from those which have brought about the apterousness of winter moths.

The report on the progress and condition of the United States National Museum for the year ending June 30, 1916, has just reached us. While bearing witness to the wide field of activities which this museum embraces, it shows also that the museum's work is fully appreciated by other departments of the State.

The Department of Justice, for example, obtained for Dr. Alěš Hrdlička, curator of physical anthropology, three months' leave of absence from the museum in order that he might undertake the anthropological examination of about 800 Chippewa Indians for the purpose of determining which should be classed as "full-bloods." This necessitated a preliminary study of the Sioux Indians of North and South Dakota. Apart from the immediate purpose of this investigation, valuable scientific results have been obtained, for in all 1200 Indians were examined, and from the data thus collected it has been possible to establish thoroughly the characteristics of the Sioux people, and to put on record the present racial status of the Chippewa people, who, as a pure race, are fast disappearing.

How thoroughly alive the U.S. Department of Agriculture is to all affecting the welfare of agriculture is well illustrated in a recent Bulletin (No. 621) by Mr. E. R. Kalmbach on "The Crow and its Relation to Man." The economic position of the common crow (*Corvus brachyrhynchos*) and its four subspecies has long been an intricate problem, and has formed the subject of many investigations, of which the most important is that of Barrows and Schwarz (1895), based upon an examination of the stomach contents of 909 birds, mainly from the eastern States. The report now issued is based upon an examination of 1340 adults and 778 nestlings. As the result of this inquiry the author shows that 25 per cent. of the yearly sustenance of the adult birds is animal matter, and 71·8 vegetable matter. Of the former 18·7 consists of insects, and of the latter 51 per cent. of corn and other grain, 3·7 per cent. of cultivated fruit, and 17 per cent. of wild fruits and seeds. The young birds remain in the nest for about three weeks. The percentage of animal food in the nestlings was 83·4, and 16·6 of vegetable matter. Of the former 48 per cent. consisted of insects, 6·2 per cent. of rodents, and 1·6 per cent. remains of poultry and their eggs. The actual corn was only about 10 per cent. Mr. Kalmbach is of opinion that the misdeeds of this bird greatly outnumber its virtues, and points out that its capabilities for good or evil are great. The attitude of farmers, he thinks, should be one of toleration where no serious losses are suffered, rather than one of uncompromising antagonism resulting in unwarranted destruction. This bird seems to fill a position somewhat analogous to that occupied by the rook in this country, and from the results obtained in this investigation we should have presumed that a considerable reduction in its numbers was advisable.

THE influence of the Cambridge geological school on palæontology outside our islands is evidenced by the appearance in 1917 of two handsomely illustrated memoirs, one by Dr. F. R. Cowper Reed, on "Ordovician and Silurian Fossils from Yunnan" ("Palæontologia Indica," vol. vi., Mem. 3, Geol. Surv. India), and the other by Mr. H. Woods, on "The Cretaceous Faunas of the South Island of New Zealand" (N.Z. Geol. Surv., Pal. Bull. No. 4).

PROF. E. W. SKEATS (*Amer. Journ. Sci.*, vol. xlv., p. 81, 1918) usefully reviews the evidence of the Funafuti boring in reference to the current discussion on the origin of barrier reefs and atolls, and points out that the discovery of a thickness of 1100 ft. of shallow-water deposits cannot be lightly set aside. On p. 194 of the same volume, he shows that the conversion of marine limestone into dolomite is commonly associated with shallow-water conditions. The rock at Funafuti from 635 ft. down to 1114 ft. is dolomitised, and hence this mineral feature affords additional evidence of subsidence of the atoll as it grew.

OWING to the difficulty most people have at the present time in getting copies of scientific periodicals published abroad, the appearance of the monthly parts of *Science Abstracts* is awaited with much less patience than was the case before the war. The indexes of the two volumes for the year 1917 have just been issued, so that the volumes now become available for reference. The physics volume deals with nearly 1400 abstracts, has 640 pages, the name-index twenty-three pages, and the subject-index forty-four pages. The electrical engineering volume deals with fewer than 870 abstracts, has only 490 pages, a name-index of eleven pages, and a subject-index of twenty-two pages. The average length of an abstract in the former volume is a little more than 0·4, and in the latter a little more than 0·5 of a page. Both show a material increase in length over abstracts of five or six years ago, due, we presume, to so many of the most experienced abstractors being otherwise occupied. The volumes remain two of the most useful issued in this country, and their cessation would entail an expenditure of time on the part of scientific workers in looking up references which cannot be contemplated with any satisfaction.

IN the *Biochemical Journal* for December last Mr. A. Weinhagen describes the reduction of phenylethylamine, prepared from phenylalanine, by shaking the aqueous solution of its hydrochloride with finely divided platinum and hydrogen. It was found that almost exactly the volume of hydrogen theoretically requisite was actually absorbed. The product of reduction is hexahydrophenylethylamine, of which the platinichloride, the aurichloride, and the picrate are described. On the other hand, all the author's attempts to reduce *synthetic* phenylethylamine by the same method were in vain, although the finely divided platinum used was shown to be active. No explanation for the failure can as yet be offered. Practically the only difference between the synthetic phenylethylamine and that obtained from phenylalanine is that the former decolorises permanganate solution only very slowly, whilst the latter does so instantly. Attempts to reduce tyrosine, phenylalanine, and *p*-hydroxyphenylethylamine in the same way were also unsuccessful.

IN our issue of March 9, 1916, we made a passing reference to the Derwent Dam, then recently completed, forming part of one of the five large reservoirs included in the Derwent Valley scheme for the supply of water to the towns of Leicester, Derby, Sheffield, and Nottingham and the counties of Derby and Nottingham. A paper by Mr. Edward Sandeman, read before the Institution of Civil Engineers on April 9, gives a fuller account of the undertaking now being carried out by the Derwent Valley Water Board. The works authorised by Act of Parliament in 1899 comprised the provision, in six large reservoirs, of a total storage capacity of 10,000 million gallons, with aqueducts, filter-beds, and other ancillary works, at an estimated expenditure of about 6,000,000*l.* One of these reservoirs, the highest and smallest, was afterwards abandoned, and the storage capacity of the Derwent reservoir correspondingly increased. The gathering ground is 31,946 acres in extent, and lies on the southern slope of the Pennine Range at an elevation varying from 500 ft. to 2000 ft. The average rainfall is 47 in. per annum. The water is very soft—2° to 3° of hardness—but is discoloured by peat when in flood. The first instalment of work, which has been completed, comprises the Howden and Derwent reservoirs, supplying 13 million gallons per day. The two dams are very similar as regards dimensions, their lengths being respectively 1080 ft. and 1110 ft.; their heights, 117 ft. and 114 ft.; and their greatest base widths, 176 ft.

and 171 ft. The foundations are in beds of black shale and sandstone. Temperature records in the masonry of the Derwent Dam, taken by means of thermophones between the years 1909–15, showed a maximum variation of 80° within 1 in. of the face, and not more than 7° at 30 ft. in the interior. The main aqueduct is 28 miles in length, and consists of 4 miles of tunnels, 7 miles of covered conduit, and 17 miles of main-pipe line.

A handy classified catalogue of college text-books and works of reference on agriculture, botany, chemistry, engineering, geology, mathematics, physics, technology, and zoology has just been issued by Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1, and should be of service to many of our readers.

OUR ASTRONOMICAL COLUMN.

The Companion to Sirius.—In a letter to the *Observatory* for April, the Rev. T. E. R. Phillips directs attention to the fact that the companion to Sirius is now readily visible in instruments of moderate aperture. This is accounted for by the circumstance that the companion is now in the neighbourhood of greatest elongation from the bright star. The star was easily observed by Mr. Phillips with an 8-in. refractor, and it was conspicuously bright in a reflector of 18-in. aperture, but in both cases a quiescent atmosphere was an essential condition. The mean of several determinations gave the position angle of the companion as 72·1°, and the separation as 10·89″. Mr. Innes, of the Union Observatory, Johannesburg, also states that the companion is now an easy object, and for 1917–18 gives the position angle 73·4°, and distance 11·24″. The observations suggest that Doberck's period of 49·49 years is too short by 0·22 year, or that the period is 49·71 years.

Physical Observations of Venus.—Among numerous observations detailed in Circular No. 41 of the Union Observatory, Johannesburg, Mr. Innes reports some interesting observations of the planet Venus. Observations were commenced on November 15, 1917, with the object of determining as nearly as possible the actual date of dichotomy, and these resulted in showing that half the visible disc was illuminated on November 23. The date given in the Nautical Almanac for this occurrence, based on geometrical reasoning, was November 29·9 G.M.T., so that the observed time was seven days in advance of the predicted time. It was remarked by all the observers that while the edge of the planet was very bright, there was a darkish lune along the terminator. It was also noted that the northern cusp was more acutely pointed than the southern.

The circular also includes measures of eighty-seven double stars, photographic observations of comet 1917*a* (Mellish) and of several asteroids, and three additional sheets of the valuable photographic atlas of the southern heavens which is being issued by the Union Observatory.

The Lunar Crater Eimmart.—Attention has previously been directed by Prof. W. H. Pickering to apparent changes in the lunar crater Eimmart, which are of a non-periodic nature and independent of the moon's phase. A careful study of this crater has been carried on at the Florence Observatory during the last three years by Dr. Maggini, who has made use of a telescope of 4-in. aperture, with powers of 175 and 300 (*L'Astronomie*, March, 1918). The crater is situated on the north-western edge of the Mare Crisium, in longitude 295° and latitude 24° N., and has a diameter of about 40 km. It is best observed about two or three days after full moon, when the Mare Crisium is near the terminator. On the western rampart there is a very small crater, which usually appears as a brilliant point, but shows a deep cavity under very oblique illumination. Following a general description of the appearances under different illuminations, Dr. Maggini gives an account of the changes noted in September, 1915, and October, 1916, when certain portions were of quite unusual brightness. The observations suggest that the changes originate in the craterlet, which is surrounded by a white deposit, extending in rays somewhat similar to those about Tycho. It seems possible that there is an occasional recrudescence of activity in the craterlet, with emission of a white substance, masking for a time the craterlet itself, and afterwards dispersing over the surface. Continued observations promise to be of considerable interest.

THE NATIONAL DYE-MAKING INDUSTRY.

To assure a national supply of dyes, independent of any foreign sources, it is necessary that in respect of each of the three stages of manufacture—(1) raw products, (2) intermediates, (3) finished dyes—this country should be self-supporting. An abundant supply of the necessary raw products is available in Great Britain, and, moreover, their manufacture in the state of purity required for the production of dye manufacture has long been carried out within the country on a very extensive scale. In respect of intermediates, at the outbreak of war we were very badly placed indeed, for although at one time or another various firms in this country had manufactured a considerable number of the necessary intermediate products, in most instances they had been forced, by continuous underselling on the part of German firms, to abandon their manufacture. This state of affairs led to the result that the British firms which manufactured colours were to a very large extent dependent upon imported intermediate products. The correctness of the statement that before a really national supply of dye can be established there must be a sufficient, and secure, supply of intermediates will not be denied by anyone who has to deal with the manufacture of colouring matters, for without them the dye-maker is in the position of the dyer who has no supply of colours. Moreover, if the dyewares that are to be produced from them are to be of a kind which will enable our textile industry to compete successfully in the open export market, every dye-maker will admit that the intermediates must be of the finest quality.

On Saturday last, April 20, a considerable party, representing the Press of this country, visited the works of British Dyes, Ltd., at the invitation of the management of the firm. The chairman of the company (Mr. J. Falconer, M.P.) and the managing director (Mr. J. Turner), in their remarks to the assembly emphasised the great importance of intermediate products, and also the fact that to ensure a sufficient national supply of these compounds of the highest quality was one of the first aims of the company. During the inspection of the works the party visited the research, technical control, and large-scale experimental laboratories; colour sheds; plant for the production of intermediates, both the trial and the large plants being included; and the various subsidiary plants for the production of the requisite heavy chemicals, gas, power, etc.; and those present were able to obtain a very fair idea of the progress that has been made by the company. It must have been gratifying to the visitors to see at work the large plants which recently came into operation for the production of some of these essential intermediate products, particularly to those who had a grasp of the great amount of preliminary work that is necessary before operations upon so large a scale can be commenced. Mistakes there are bound to have been, but that the company has made a definite step towards its objective, and towards the assurance of a national supply of dyes for this country, cannot be denied. On the other hand, what has been accomplished is but small in comparison with what remains to be done; for the large plants visited produce but a small fraction of the total number of intermediates that are of primary importance. Despite this, when the actual progress that has been made by British Dyes, Ltd., and by other firms, in the face of the great difficulties of the times, is fairly surveyed, the confidence that British chemists and engineers can place the country in a position of independence as regards dyes is confirmed, but it is also clearly seen that this result can only be achieved by years of strenuous work, by co-operation, and with the aid of sympathetic national support of the industry.

A. E. E.

SCIENTIFIC PROBLEMS OF REFRIGERATION AND COLD STORAGE.

A COMMITTEE has been set up by the Food Investigation Board of the Department of Scientific and Industrial Research to consider engineering and physical problems which arise in connection with the use of cold to preserve food, and to organise such research on these subjects as may be considered necessary.

The Committee consists of Sir Alfred Ewing (chairman), principal, University of Edinburgh; Sir Richard Glazebrook, director, National Physical Laboratory; Commdr. C. F. Jenkin, professor of engineering science, Oxford; Mr. S. R. Beale, of Messrs. Louis Sterne and Co.; Prof. H. L. Callendar, professor of physics, Imperial College of Science and Technology; Messrs. G. C. Hodsdon and F. A. Wilcox, of Messrs. J. and E. Hall, Ltd.; Prof. C. H. Lees, professor of physics, East London Technical College; Mr. A. Macdonald, superintendent engineer of the Commonwealth and Dominion Line, Ltd., of the Cunard Line; Mr. J. T. Milton, chief engineer surveyor of Lloyd's Register of Shipping; Mr. W. B. Statham, of the Messrs. Lightfoot Refrigerating Co.; Mr. J. Thom, chief engineer of the London Central Markets Cold Storage Co.; and Mr. A. R. T. Woods, general manager of the H. and W. Nelson Line.

The terms of reference to the Committee are designedly wide, so that its activities may be as little hampered as possible. They cover refrigerating machines and the insulation of cold stores in general, and in particular the application of refrigeration in ships, barges, and railway vans for the conveyance of produce at low temperatures, and the methods of measuring the temperature and degree of moisture in closed spaces.

The Committee may be said to be taking up work at the point at which it was left by the Refrigeration Research Committee of the Institution of Mechanical Engineers, but with greatly extended terms of reference. That committee, which was also under Sir Alfred Ewing, was appointed to define a standard in refrigeration, and the valuable results of its deliberations were issued as a report of the institution in October, 1914.

In setting up the present Committee an attempt has been made to include experts representing each division of the subject, and in attempting a general survey of the scientific problems which press for solution on the engineering and physical sides the Committee will be guided by the first-hand knowledge of its members. It includes engineers with much experience in the practical work of refrigeration, and also physicists familiar with the methods of experimental research which are likely to be relevant.

No single committee, however, can hope to possess an exhaustive acquaintance with all aspects of so wide a question. The work will therefore be helped forward by suggestions received from without, and the Committee would welcome suggestions as to specific questions on which further knowledge is needed. Any communication should be addressed to the Secretary, Sir Alfred Ewing's Committee, Scientific and Industrial Research Department, 15 Great George Street, Westminster, S.W.1.

PRESENT AND PROSPECTIVE FOOD SUPPLIES.

RECENT reviews of the outlook for food supplies after the war have been so uniformly pessimistic that a note of comparative optimism from so eminent an authority as Sir R. Henry Rew is doubly welcome at the present juncture. In his address to the Royal Statistical Society on December 18 last (Journal of the Royal Statistical Society, January, 1918) Sir Henry was able to arrive at the conclusion that the prospects of food supplies for the hungry world after the war are at least not hopelessly gloomy, although indeed his considerations were limited solely to supplies, and did not cover the problem of transport.

Dealing first with breadstuffs, and reviewing the existing position as regards production and requirements in the chief importing and exporting countries, he deduced that although there is an immediate deficiency of normal breadstuffs, available to meet the existing demand, there is no shortage in the world's supplies as a whole, if Australia be included. Moreover, the shortage affects only the northern hemisphere, and, so far as can be judged, the wheat crops south of the equator will compensate for the deficient wheat crops north of it. As to the food situation which will exist when the war ends, it is by no means certain that the Central Powers will draw heavily upon extra-European sources of supply, since their needs will probably be met adequately from Russia and the Balkans. Another factor which must be taken into account is the reduction in the number of bread-eaters in the countries at war. It is difficult to assess the present reduction of food requirements from this cause at less than one million tons of cereals alone. Moreover, it is probable that demobilisation will lead to a reduction in the average food consumption per head of the men affected, and that the general economy in the use of food which war conditions have engendered will persist for a considerable period.

As regards meat, there has been a serious reduction in the number of cattle, sheep, and pigs in Europe during the war, but, on the other hand, a very substantial stimulus has been given to the overseas trade in meat, and sources of supply hitherto almost untapped, such as Brazil and South Africa, are being steadily developed. On the whole, therefore, Sir Henry found reason to believe that there are, and will be, adequate supplies of meat in the world to satisfy the demands of carnivorous Europe, again assuming, as in the case of breadstuffs, that they can be shipped. Transport is thus obviously the dominant factor, and no optimism as to the world's supplies can modify the grave fact that the most rigid economy of food is essential throughout the war, since the food available is limited, not by the world's supply, but by the quantity which can be brought to, or produced in, the country which needs it.

The optimism expressed in the paper was not entirely shared by speakers in the subsequent discussion, Mr. Udny Yule, in particular, giving reasons for belief that Sir Henry's estimates of the exportable surplus of wheat from North and South America would not be realised. He agreed, however, that the outlook as regards cereals was less serious than as regards meat. The cereal supply might recover with comparative rapidity after the war if the land had not become seriously foul and impoverished, but it might be some years before the meat supply attained anything like its former plenty.

SLEEPING SICKNESS AND BIG GAME.

We have received the report of the Sleeping Sickness Commission of the Royal Society, No. xvi. (pp. 221+17 plates+3 maps), which bears date 1915, but has only just been distributed. This volume, most of the papers in which have been already published in the Proceedings of the Royal Society, gives an account of the investigations carried on by the commission, under the direction of Sir David Bruce, in Nyasaland in 1912–14. The most important conclusion of the commission was that *Trypanosoma brucei*, the cause of nagana in Zululand and other parts of Africa, is identical with *T. rhodesiense*, the trypanosome causing sleeping sickness in man in Nyasaland and Rhodesia. On account of the marked infectivity of the game in the fly-country—"and this fact stands out most prominently and without any shadow of doubt"—it is recommended that efforts should be made to diminish the number of wild animals in fly-areas, *e.g.* by removing all restrictions regarding the pursuit and killing of the game. Removal of infected natives, though they are apparently few and far between, to fly-free areas, and the clearing of the forest around villages so as to keep the fly away, are also useful measures, and the suggestion is made that for purposes of administration it would be well to gather the natives together in fairly large villages. Direct measures for the destruction of the fly are not considered to offer any chance of success, but "when the country becomes opened up, cleared, and settled, the big game will disappear and the tsetse with them."

Major Cuthbert Christy contributes to the *Annals of Trop. Med. and Parasitology* (vol. xi., No. 3, pp. 279–282) a note on tsetse-flies and fly-belts in Central Africa, in which he expresses the opinion that if, in speaking of wild animals or great game, the antelopes are referred to, he is convinced that they play a quite negligible part, if any, in relation to sleeping sickness in man, and that it is possible to exclude with certainty most of the wild animals, though he places one or two under suspicion. Of these, he considers the pig will be found to be the chief culprit, not only the common red river-hog and the wart-hog, but more especially the semi-domesticated pig frequently seen about native villages.

METALLURGY OF COPPER.

The Cantor lectures on "Progress in the Metallurgy of Copper," delivered by Prof. H. C. H. Carpenter before the Royal Society of Arts in December last, have just been published. Prof. Carpenter commences with a brief review of the early methods of copper smelting, giving some interesting details of the process in use at Keswick, Cumberland, towards the end of the sixteenth century, traces the origin and rise of the industry of copper smelting in Swansea and the adjoining districts of South Wales, and thus comes to the early years of the nineteenth century, when the influence of the importation of Chilian ores, followed by the utilisation of the vast deposits of Huelva and the adjoining part of Portugal, first made themselves felt. By the end of the nineteenth century the huge copper resources of the United States of America dominated the world's markets, and from that period, when the United States was producing one-half of the copper output of the entire world, up to the present day, American practice has exerted a preponderating influence upon the metallurgy of copper.

Prof. Carpenter gives a full and interesting account of modern American methods, as exemplified in the works of the famous Anaconda Copper Mining Company, and shows well the development of the most modern improvements, especially in the application of the flotation process and of hydro-metallurgical processes. He concludes with an account of the last-named method as applied in the works of the Chile Exploration Company at Chuquicamata, where it is being employed on a vast scale, and points out that the modern tendency in the metallurgical treatment of copper ores is to replace smelting methods by wet methods, so that the similarity between modern processes for the treatment of gold and of copper is becoming more and more pronounced.

Incidentally, attention may be directed to a statement of Prof. Carpenter to the effect that "in the time of Elizabeth, James, etc., the metalliferous ores of this country were reserved to the Crown." This is a mistake; for whilst it is true that in earlier times the Crown had laid claim to such ores, this pretension was constantly resisted, and in 1568 it was definitely disposed of by the Great Case of Mines, in which the judges declared unanimously that if a metalliferous ore or mine contains no royal metal—*i.e.* neither gold nor silver—the proprietor of the soil is owner of the ore or mine in question. It is thus clear that even in the earlier part of Queen Elizabeth's reign the law gave a definite decision to exactly the opposite effect to that stated by Prof. Carpenter. H. L.

THE ORGANISATION OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

Last October Mr. G. Hogben and Dr. J. Allan Thomson submitted to the New Zealand Minister of Internal Affairs a report on schemes adopted in various parts of the British Empire and in the United States for the organisation of scientific and industrial research.

The following abridgment of the report provides a summary of the progress already made and of the plans proposed for the future:—

Great Britain.

By Order in Council, July 28, 1915, a Committee of the Privy Council was appointed to direct the application of any sums of money provided by Parliament for the organisation and development of scientific and industrial research. It was further ordered that, for these purposes, there should be an Advisory Council (which consisted at the outset of eight eminent scientific men, three at least of whom were actually engaged in industries dependent on scientific research). To it stood referred for their report and recommendation proposals (i) for instituting specific researches; (ii) for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades; and (iii) for the establishment and award of research studentships and fellowships.

The sum voted for the first year was 25,000*l.* For the second year (1916–17) the sum voted by Parliament was 40,000*l.*, but during the course of the financial year the Government decided to establish a Department, the Department of Scientific and Industrial Research, to take the functions and powers of the

Committee of the Privy Council, the official members of which became a trust to administer public and other funds given for the purpose named. The appropriation for the year accordingly took the following amended form :—

	£
(*a*) Salaries, wages, and allowances ...	7,250
(*b*) Travelling and incidental expenses ...	800
(*c*) Grant for investigations carried out by learned and scientific societies, etc. ...	24,000
(*d*) Grants to students and other persons engaged in research	6,000
(*e*) Scientific and industrial research (grant in aid)	1,000,000
	£1,038,050

Items (*a*) to (*d*) are ordinary annual votes which lapse at the end of the financial year. Items (*c*) and (*d*) are to be distributed by the Committee of the Privy Council, on the recommendation of the Advisory Council, and are intended to meet cases in which assistance is required by the individual worker or by learned, scientific, or professional societies which stand in need of funds to carry on research work. Item (*e*) was paid to the Imperial Trust for the Encouragement of Scientific and Industrial Research, and is intended to cover expenditure for the next five years.

Imperial Scheme.

Consequent upon the publication of the proposals for the original British scheme, suggestions were made by the Minister of Public Works of Victoria and by the Premier of New South Wales that the scheme should be extended and made applicable to the Overseas Dominions, or even to the Empire as a whole. A memorandum drawn up by the British Committee of Council was therefore, on March 2, 1916, circulated to all the Governments of the Overseas Dominions, concurring in the suggestion, and inviting each Government to constitute some body or agency having functions similar to those of the Advisory Council which acts for the United Kingdom. The memorandum lays stress upon two points: First, any body or agencies instituted for the purpose should, under their respective Governments, have really responsible functions and substantial authority; secondly, a close connection should be maintained between these bodies and the public educational systems and institutions of their respective countries.

Commonwealth of Australia.

An Advisory Council of Science and Industry was appointed on March 16, 1916. Since that date additional appointments have been made, so that the Council now consists of thirty-five members representative of both science and industry, and includes members from all the Australian States. It is a temporary body, designed to prepare the ground for a proposed permanent Institute of Science and Industry, and to exercise in a preliminary way the functions that will in future belong to the institute. The chief of these functions are :—(i) To consider and initiate scientific researches in connection with, or for the promotion of, primary or secondary industries in the Commonwealth, and (ii) the collection of scientific industrial information and the formation of a bureau for its dissemination amongst those engaged in industry.

At its first meeting the Advisory Committee elected an Executive Committee, of which the Prime Minister (or, in his absence, the Vice-President of the Executive Council) is chairman. The deputy-chairman is Prof. D. Orme Masson. The Executive Committee at first consisted of six members besides the chairman; to these were afterwards added the chairman of the several State Committees as members of the Executive Committee *ex officio*.

The Committee in each State consists of the State representatives on the Advisory Council, together with any other associate members appointed on the nomination of State Governments, one of whom is generally a professor of the university.

The first work of the Advisory Council was, *inter alia* :—

(1) To make a register or census (*a*) of Australian industries, their distribution and importance; (*b*) of problems connected with them; (*c*) of the equipment and *personnel* of laboratories available for industrial scientific research; (*d*) of research work in actual progress in laboratories and at Government experimental farms; and (*e*) of the facilities available for the proper training of future scientific investigators.

(2) To establish relations with other authorities, as State Governments, scientific and technical departments, universities, technical colleges, scientific societies, and associations and committees representing the pastoral, agricultural, manufacturing, and other industries.

(3) To encourage and co-ordinate researches already in progress (much of the work of the Executive has been of this kind).

The next step was the initiation of new researches. Having collected all the information from reports and experts on any special question, the Executive appointed in each approved case a small Special Committee to report further or to carry out actual experimental investigation. In the latter case the Executive selected the locality and the institution for conducting the research, appointed a salaried investigator to assist the Special Committee, and voted a reasonable sum for expenses.

Twenty such Special Committees were appointed up to June 30, 1917: some of these committees each carried out or initiated several researches. Their work was in addition to the research work being carried out by Government Departments, by such societies as the Pastoralists' Committee, and by universities and other institutions or by two or more of these bodies acting together.

The scheme distinguishes between laboratories primarily for scientific research and laboratories primarily for the necessary routine work of departmental testing. It is recommended that (*a*) the control of the present Commonwealth laboratories should not be disturbed, but that they should be co-ordinated, their staffs increased, and their equipment improved; (*b*) any new national laboratories which may be created for special purposes of research and experimental inquiry, including a physical laboratory for testing and standardising purposes, should be controlled by the institute.

The Executive Committee urgently recommends the establishment of the permanent institute under statutory authority. It advises (i) that an Advisory Council consisting of nine members representing science and the principal primary and secondary industries should be appointed by the Governor-General in Council; (ii) that, for the purpose of controlling and administering the institute and of collecting information and determining on the researches to be undertaken and directing their elucidation, three highly qualified salaried directors, of whom one should be chairman of the directors, should be appointed by the Governor-General in Council; (iii) that of the three directors one should be an expert business and financial man with ability in organisation; the other two should be chosen mainly on account of scientific attainments and wide experience; their tenure should be fixed by the Act; and that the scientific staff should be appointed by the Governor-

General in Council on the recommendation of the directors.

It is intended that so far as possible the Advisory Council shall act in co-operation with the Advisory Council of the Imperial Privy Council and with similar bodies in other parts of the Empire.

It is understood that for the carrying out of the original scheme the Prime Minister stated that the Commonwealth Government was prepared to spend 500,000*l.*

Canada.

On the recommendation of the Minister of Trade and Commerce, the Governor-General in Council approved, on June 6, 1916, of the appointment of a Committee of the Privy Council, consisting of the Minister of Trade and Commerce, the Minister of the Interior, the Minister of Mines, the Minister of Inland Revenue, and the Minister of Agriculture, which should be charged with, and responsible for, the expenditure of any moneys provided by Parliament for scientific and industrial research; and also of an Honorary Advisory Council, responsible to the Committee of Council, to be composed of nine men representative of the scientific and industrial interests of Canada, who should be charged with the following duties:—(*a*) To consult with all responsible bodies and persons carrying on scientific and industrial research work in Canada with the view of bringing about united effort and mutual co-operation in solving the various problems of scientific and industrial research which from time to time present themselves; (*b*) to co-ordinate so far as possible the work so carried on so as to avoid overlapping of effort and to direct the various problems requiring solution into the hands of those whose equipment and ability are best adapted thereto; (*c*) to select the most practical and pressing problems indicated by industrial necessities and present them when approved by the Committee to the research bodies for earliest possible solution; (*d*) to report from time to time the progress and results of their work to the Minister of Trade and Commerce as chairman of the Committee of Council.

On November 29, 1916, the nine members of the Honorary Advisory Council were appointed, six of them being presidents or professors of Canadian universities. On December 13, 1916, the number of the members of the Honorary Advisory Council was raised to eleven, and Dr. A. B Macallum was appointed permanent chairman of the said Council, with headquarters at Ottawa, with a salary of 2000*l.* per annum.

United States of America.

In the United States before the war scientific research was probably better organised than in any other country except Germany. The chief agencies were several important Government scientific bureaux; certain institutions privately, and in a few cases munificently, endowed for research; some universities and schools of technology carrying on researches, and scientific societies and industrial corporations giving a certain amount of opportunity for, and support of, research. What was chiefly wanting was organisation and co-ordination, to avoid overlapping and to secure the proper distribution of effort over the whole field in which scientific research in connection with national defence and industrial efficiency was likely to be profitable.

In April, 1916, the National Academy of Sciences offered its services to the President of the United States in the interest of national preparedness. President Wilson accepted the offer, and, after preliminary work by an organising committee and the appointment of representatives of the Army, Navy, Smithsonian Institution, and various scientific bureaux of the Government and of universities, scientific associations, and of engineering institutes and societies, the National Research Council was formed, and held its first meeting in September, 1916. The council consisted of thirty-seven members, Dr. George E. Hale, director of the Mount Wilson Solar Observatory, being chairman. The main work, however, is done by the Executive Committee, consisting of ten members (now more), of which Mr. J. J. Carty, chief engineer of the American Telephone and Telegraph Co., is chairman. Committees were also set up to prepare a national census of research and of the equipment and *personnel* available, and for other purposes of organisation.

The research committees are of two kinds: (*a*) central committees, dealing with various departments of science, composed of leading authorities in each field; (*b*) local committees in universities, colleges, and other co-operating institutions engaged in scientific research; and other special committees.

It is not intended to supersede or to interfere with existing institutions carrying on research, but where necessary to increase their usefulness by placing additional funds at their disposal and in other ways. For instance, each State is to have an additional grant of 3000*l.* a year for research conducted by institutions situated in it. The Throop College of Technology, a research institute in California, received a grant of 20,000*l.*, and the Massachusetts Institute of Technology a gift of 100,000*l.*, to be used for the most part for research.

The relation between the central committees and the local and other special committees may be illustrated by reference to chemical research. There is a central committee of chemistry, which deals in the first instance with all industrial problems connected wholly or mainly with chemistry. This committee defines the specific problems to be investigated, and assigns them to the local committees at certain institutions, or to other special committees consisting of experts in the branch in question.

South Africa.

As a consequence of the memorandum from the Committee of the Privy Council the South African Government towards the end of the year 1915 appointed a Committee under the title of the Government Munitions and Industries Committee, the members being representative of the chambers of commerce and manufacturers' associations. The work of this Committee was in the main confined to practical engineering matters, and by no means covered the whole field of industrial research.

In October, 1916, the Government appointed an Industries Advisory Board, which was intended to have a wider scope; its members, who were to hold office for three years, were almost exclusively business men representative of commerce, manufactures, and labour.

In February, 1917, the Advisory Board recommended "the appointment of a Scientific and Technical Advisory Committee to deal with all scientific and technical questions, and questions of research which may be referred to them by the Industrial Advisory Board." The Government accordingly constituted a Committee of ten members—men of science and engineers—the functions of which were to be to provide for scientific research; to co-ordinate industrial investigation and research in South Africa; to co-operate with other Government Departments in South Africa and with similar Departments in the United Kingdom and the Dominions; to carry out an economic survey of the resources of South Africa; and to deal with certain other economic, industrial, statistical, and educational matters. Both the Board and the Committee are under the control of the Minister of Mines and Industries. The Committee has begun its work by instituting a general survey of the position in the Union under forty-eight special headings, covering a wide range of natural and manufactured products of South Africa, each portion of the "survey" being entrusted to a reporter, who is apparently a scientific or technical expert.

New Zealand.

The British memorandum on the suggestions for making the British scheme applicable to the whole Empire was referred by the Hon. Minister of Internal Affairs to Dr. Thomson for report. At that time the original Australian proposals were also available in New Zealand. Dr. Thomson's report consisted of two parts, the first exposing the defects of the pre-war relationship between science and industry, the second outlining proposals for New Zealand.

At the annual meeting of the New Zealand Institute on January 31, 1917, the reports of the affiliated societies were adopted, and the following resolutions were passed:—(1) That scientific research be endowed to a very much greater extent than has been done in the past; (2) that the importance of research in pure science be recognised as of equal importance with that in applied science; (3) that as a definite step towards the endowment of research adequate provision be made for the appointment of fully qualified assistants to the professors of science in the four university colleges; (4) that a Board of Science and Industry be constituted, to consist of (*a*) members selected by the New Zealand Institute; (*b*) representatives of the scientific Departments of the Government; and (*c*) leaders in industry and commerce. This Board to recommend and direct research problems, and to have power to spend money voted by Parliament for the purpose.

The New Zealand Institute further offered its services at a deputation to the Acting Prime Minister, and received the reply that the matter would be referred to the National Efficiency Board, the setting up of which was contemplated.

The Standing Committee of the New Zealand Institute has, at the request of the Efficiency Board, set up an Industrial and Research Committee in Wellington to receive and co-ordinate suggestions from the affiliated societies of the institute and from other bodies interested, and to frame a scheme for submission to the board of governors. Consequent on the resignation of the National Efficiency Board, the chairman of that board has intimated that it is the desire of the Government that the New Zealand Institute should proceed with its deliberations and report directly to the Government.[1]

In the meantime the General Council of Education had set up a Recess Committee to consider the adaptation of the educational system of the Dominion to the development of its resources. The Committee met in Christchurch from May 16 to 18, and the report dealing with scientific research was adopted by the Council in the following form:—

(1) There should be a National Advisory Council on Research, consisting of (*a*) four scientific men, one of whom should be a scientific expert attached to a Government Department, (*b*) three members connected with leading industries of the Dominion, one of whom should represent agriculture.

(2) (i) The National Advisory Council should consider and allot to the proper persons for investigation all proposals for specific researches (or at its discretion reject such proposals). The proposals might be referred to it by the Efficiency Board, or might come from institutions, or societies, or private persons, or might originate in the Council itself. (ii) The Council might also consider the problems affecting particular industries, to determine along what lines research might be instituted. (iii) The Council should award and supervise the tenure of the research fellowships mentioned below, and should, on the request of the University of New Zealand, consult with and advise the Senate of the University in matters relating to the national research scholarships in the award of that body. (iv) The Advisory Council should consider and advise the General Council of Education as to the lines along which there could be brought about a general improvement in scientific education with the view of the training of experts, and should co-operate with that Council and other public bodies in taking such steps as may lead to the better appreciation of the aims and advantages of science on the part of producers and the general body of citizens.

(3) In addition to the existing national research scholarships (the number of which should be increased) there should be established research fellowships tenable for two, three, or more years by men or women qualified and willing to conduct researches approved by the Council. (The fellowships should be of sufficient value to prevent the possible holders from being attracted away to other positions.)

(4) The University and the University colleges should assist the fellows in their research in such ways as may be arranged.

(5) It is suggested that three Ministers of the Crown should form a Research Committee of the Executive Council, and that all the proposals of the National Advisory Council involving additional expenditure or a question of policy should come before the Committee for approval. Except in this respect the National Advisory Council should not be considered as a department of the public service, but should be free to act as it thought fit in regard to matters within its control.

(6) (i) In further explanation of the functions of the National Advisory Council it is suggested that the following should be included among them. The Council might (*a*) recommend to industrial firms or companies scientific managers, superintendents, assistants, or scientific experts; (*b*) advise industrial firms or companies as to improvements in the arts and processes employed, and as to the utilisation of waste products; (*c*) make recommendations as to the adoption in any industry of the results of investigations conducted under its directions; (*d*) undertake the investigation of industrial problems that, if unsolved, would obstruct the development of industries concerned; (*e*) advise the Government in regard to the help that should be given to any new industry that is likely to be ultimately of value to the country, though at first it may not be worked except at a loss. (ii) The Council might advise the Government as to what contribution, if any, should be made towards the cost of any research by the firms or companies concerned.

(7) That all bulletins and reports relating to the researches set up by the Council should be drawn up and published with its authority.

(8) That the Council of Education communicate with the chambers of commerce, the annual conferences of the Agricultural and Pastoral Association, the New Zealand National Dairy Association, and the New Zealand Farmers' Union intimating that the Council would welcome any suggestion from these bodies as to how the educational agencies of the Dominion might assist in achieving the purpose of bringing the produce of our New Zealand industries into the most profitable relationship with the markets of the world.

(9) That the attention of the Government be directed to the necessity for establishing a course for the training of hydro-electric engineers.

During the past year various industrial bodies have discussed the general question, and passed resolutions approving of increased Government aid to industrial research, but no details of any scheme have been framed by them.

[1] In view of the reappointment of the National Efficiency Board, the institute will presumably report to that body as originally requested.

THE FREQUENCY OF EARTHQUAKES.[1]

THE publication of an abstract of twenty years' record of earthquakes in Italy gives an opportunity for studying the effect of the gravitational attraction of the sun; the period is so nearly coincident with the lunar cycle of nineteen years that the effect of the moon may be regarded as eliminated, the record is of exceptional continuity and completeness, and the number of observations is large enough to allow of the extraction of groups sufficiently numerous to give good averages.

The distribution of the stresses throughout each diurnal period presents two peculiarities: first, the range of stress is greater during the day than during the night in summer, with an opposite variation during winter; secondly, the general effect of the vertical component is towards a progressive diminution of the downward pressure during the six hours preceding, and towards an increase during the six hours following, the meridian passages at noon and midnight.

Investigating the first of these, a division of the year into two parts, at the equinoxes, gives a proportion of shocks during the day to those during the night, somewhat greater than the average during the summer half, and somewhat less during the winter. As this result might be purely fortuitous it was tested by a similar treatment of two other records which stood ready for use—Milne's catalogue of Japanese earthquakes from 1885 to 1892, and the after-shocks of the Indian earthquake of 1897. They show a variation identical in character with that of the Italian record. A second test depends on the argument that, if the variation is in any way seasonal, the divergence should be increased at the height of each season; the figures for the months of January–February and of June–July were taken out, as representing midwinter and midsummer respectively, and found to show a divergence in each case greater than, and in the same direction as, the respective half-years.

The actual figures are as follows, the frequency being expressed as a ratio to the mean, of each group, taken as 100:—

Distribution of Shocks by Day and Night.

	Day	Night
Italy, 1891–1910.		
June–July	90	110
Summer half	88	112
Whole year	84	116
Winter half	81	119
December–January	77	123
Japan, 1885–1892.		
Summer half	102	98
Whole year	97	103
Winter half	93	107
Assam After-shocks.		
Summer	113	87
Whole record	107	93
Winter	101	99

Taken by itself the variation, as between any pair of ratios, is as likely to be in one direction as in the other, but the odds against a complete concordance throughout the whole series are 31 to 1; it may, therefore, be taken that the variations are not fortuitous, but due to some common cause which tends to increase the frequency during the day and decrease it during the night in summer, with the opposite in winter.

For the second line of investigation a computation was made of the mean amount of stress for the whole of Italy and the whole year for each of the six hours preceding and following the meridian passage. These were plotted and compared with the corresponding curve of frequency of earthquakes; the result showed no apparent relation between the frequency and the total, or the horizontal, stress, though a close one with the variation of the vertical stress, the greatest number of earthquakes being in the period in which there is the greatest increase of downward pressure. As the rate of increase diminishes the frequency of shocks is less, suffering a further diminution as the pressure begins to decrease, and reaching its minimum in the period where the decrease in pressure is greatest, increasing again in the same way to the maximum.

The Japanese record is not directly comparable with the Italian, being dominated by the after-shocks of great earthquakes of the world-shaking type, and nearly half of the whole record consists of after-shocks of the Mino-Owari earthquake of 1891. Taking these separately, we get a curve of frequency similar to the Italian, except that the maximum and minimum are reversed, the greatest number of shocks corresponding with the period when the load is being lightened most rapidly, indicating that these shocks were due to a general movement of elevation rather than depression, a conclusion in accord with field observations of other great earthquakes.

The actual figures of variation of stress, in Italy, and the frequency of earthquakes are as follows:—

Hours	XII	II	IIII	VI	VIII	X	XII
Mean range of vertical stress in each two hours, Italy.	−0·14	−0·27	−0·13	+0·13	+0·27	+0·14	
Ratio of actual to mean frequency of each two-hour period, Italy, 1891–1910... ...	1·06	1·17	1·01	0·90	0·88	0·99	
After-shocks of Mino-Owari, Oct. 28, 1891, Japan.	1·01	0·95	0·96	0·97	1·08	1·03	

The principal point of interest in these figures is that they give a means of estimating the rate of growth of the strain which produces earthquakes. Accepting the hypothesis that earthquakes are due to the relief by fracture of a growing strain when this has reached the breaking point, it can be shown that a variable strain, acting alternately in increase or decrease of the general growth, while leaving the average rate of growth unaltered, will give rise to a corresponding variation in the frequency of shocks in each period, and, besides that, there is a simple relation between the magnitudes of the two stresses, to which the strains are due, and the variations from the mean frequency of earthquakes. A calculation based on this shows that the growth of strain for Italy is such that the breaking strain would be reached in about three and a half years, starting from a condition of no strain. The after-shocks of the Mino-Owari earthquake give about five to six months, if account is taken of the difference between the resistance of rock to tension and compression. These figures are given for what they are worth; at the least they are of interest as being the first authentic estimate which it has been possible to make of the time required to prepare for an earthquake, and, thence, of the rate of growth of the particular tectonic process involved in their production.

[1] From a paper entitled "Some Considerations arising from the Frequency of Earthquakes," read before the Geological Society on February 6 by R. D. Oldham, F.R.S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

In spite of the war, changes have been carried through with the object of placing higher technical education in Holland on a university basis. About twenty years ago the engineering and technological college at Delft became a technical university; later, a commercial high school was started at Rotterdam. Now the Minister of Agriculture has brought about the reorganisation of the veterinary college at Utrecht and the agricultural college at Wageningen; both these have recently been converted into institutions of university rank. It was at the Utrecht veterinary school that van't Hoff taught chemistry and physics from 1875 to 1877, before his appointment to a professorship at Amsterdam.

SOCIETIES AND ACADEMIES.

London.

Zoological Society, April 9.—Dr. A. Smith Woodward, vice-president, in the chair.—Miss J. **Proctor**: The variation of the pit-viper, *Lachesis atrox*. The paper dealt with the variation of the principal characters of the Central and South American pit-viper, *Lachesis atrox*, L., of which the author regarded *L. lanceolatus*, Lacép., as a synonym, and *L. affinis*, Gray, *jararaca*, Wied, and *jararacussu*, Lacerda, as varieties. The author laid special stress on the different patterns of markings, discussing their evolution and regarding that shown by the more northern form, *L. affinis*, as the most primitive, from which all others could be derived.

Mathematical Society, April 18.—Prof. E. W. Hobson, vice-president, in the chair.—P. A. **MacMahon**: The attraction of a circular disc.—H. **Hilton**: *n*-Poled cassinoids.

BOOKS RECEIVED.

Malaria in Macedonia: Clinical and Hæmatological Features and Principles of Treatment. By P. Abrami, G. Paisseau, and H. Lemaire. Translated by Dr. J. D. Rolleston. Pp. xxx+115. (London: University of London Press, Ltd.) 6*s*. net.

The Science and Practice of Photography. By Dr. J. R. Roebuck. Pp. xiv+298. (New York: D. Appleton and Co.) 2 dollars net.

Medical Contributions to the Study of Evolution. By Dr. J. G. Adami. Pp. xviii+372. (London: Duckworth and Co.) 18*s*. net.

A Text-book of Mycology and Plant Pathology. By Prof. J. W. Harshberger. Pp. xiii+779. (London: J. and A. Churchill.) 15*s*. net.

A Treatise on the Principles and Practice of Harbour Engineering. By Dr. Brysson Cunningham. Second edition. Pp. xvi+377. (London: C. Griffin and Co., Ltd.) 25*s*. net.

DIARY OF SOCIETIES.

THURSDAY, April 25.

Royal Society, at 4.30.—Bakerian Lecture: Experiments on the Production of Diamond: Sir Charles Parsons.

Institution of Electrical Engineers, at 6.—Large Batteries for Power Purposes: E. C. McKinnon.

FRIDAY, April 26.

Royal Institution, at 5.30.—Food Production and English Land: Sir A. Daniel Hall.

Physical Society, at 5.—Notes on the Pulfrich Refractometer: J. Guild.—The Accuracy attainable with Critical Angle Refractometers: F. Simeon.—Cohesion: Dr. H. Chatley.

SATURDAY, April 27.

Royal Institution, at 3.—Modern Investigation of the Sun's Surface: Prof. H. F. Newall.

MONDAY, April 29.

Aristotelian Society, at 8.—The Conception of Social Orders: Prof. H. J. W. Hetherington.

TUESDAY, April 30.

Royal Institution, at 3.—Cave-hunters: Prof. A. Keith.

Royal Society of Arts, at 4.30.—British Guiana: Sir Walter Egerton.

WEDNESDAY, May 1.

Royal Society of Arts, at 4.30.—Sugar from several Points of View: G. Martineau.

Entomological Society, at 8.

Geological Society, at 5.30.—The Relationship between Geological Structure and Magnetic Disturbance, with Special Reference to Leicestershire and to the Concealed Coalfield of Nottinghamshire: Dr. A. Hubert Cox.

Society of Public Analysts, at 5.—Factors Affecting the Composition of Plant Ashes, with Special Reference to Tobacco: O. D. Roberts.—The Effect of Codeine in Hindering the Precipitation of Morphine by Ammonia from a Solution of its Lime Compound: H. E. Annett and H. Singh.—Analysis of "Cocoa Teas": J. L. Baker and H. F. E. Hulton.

THURSDAY, May 2.

Royal Society, at 4.30.—*Probable Papers*: Nerve End Cells in the Dental Pulp: Dr. J. H. Mummery.—The Nature of Growths in Colloidal Silica Solutions: H. Onslow.

Royal Society of Arts, at 4.30.—The Freedom of the Seas: Gerard Fiennes.

Linnean Society, at 5.—A New Fresh-water Shrimp (*Caridina*) from Fiji: G. M. Thomson.—(1) *Bennettites scottii*, sp. nov., a European Petrifaction with Foliage; (2) A Survey of the Biological Aspect of the Constitution of Coal: Dr. Marie Stopes.

FRIDAY, May 3.

Royal Institution, at 5.30.—The Spinning Top in Harness: Sir G. Greenhill.

Institution of Mechanical Engineers, at 6.—Employment of Women in Munition Factories: Miss O. E. Monkhouse (*Discussion*).

SATURDAY, May 4.

Royal Institution, at 3.—Modern Investigation of the Sun's Surface: Prof. H. F. Newall.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., Ltd.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: Phusis, London.
Telephone Number: Gerrard 8830.

THURSDAY, MAY 2, 1918.

OUR HERITAGE OF SCIENCE.

(1) *Britain's Heritage of Science.* By A. Schuster and A. E. Shipley. Pp. xv + 334. (London: Constable and Co., Ltd., 1918.) Price 8s. 6d. net.

(2) *A Short History of Science.* By Prof. W. T. Sedgwick and Prof. H. W. Tyler. Pp. xiv + 474. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 12s. 6d. net.

(1) THE main purpose of the first of these two historical books is to give a plain account of Britain's great heritage of science: "an heritage that—handed down through several centuries of distinguished achievements—will, if the signs speak true, be passed on to the coming age with untarnished brilliancy." It is a legacy to be proud of and to use. Prof. Schuster starts off with a fine chapter on the ten landmarks of physical science associated with the names of Roger Bacon, Gilbert, Napier, Newton, Dalton, Young, Faraday, Joule, William Thomson, and Clerk Maxwell. Then follows a sketch of physical science in the universities during the seventeenth and eighteenth centuries, and the achievements of men like Halley and Hooke, Bradley and Black. The non-academic succession is illustrated by the work of Boyle, Cavendish, Priestley, Herschel, and Watt. Through Rumford and Davy and George Green the author passes to the golden age of mathematics and physics at Cambridge associated with the names of Stokes and Adams, Sylvester and Cayley. His survey broadens out to include the work of Thomson and Tait, Rankine and Fitzgerald, and other illustrious physicists of the nineteenth century. Thus the author deals with such investigators as Graham, Joule, Balfour Stewart, Reynolds, Sorby, Crookes, Rayleigh, George Darwin, Ramsay, Rutherford, Airy, John Herschel, Adams, and Gill, and the distinguished roll fitly ends with Henry Moseley, whose career of singular promise was cut short in 1915 by a Turkish bullet. The next chapters illustrate the function of scientific institutions, such as the Royal Society, and "the effects of pure scientific research on that complex organisation of the community which usually goes by the name of civilisation."

Prof. Schuster's historical sketch is illuminating and inspiring—a fine example of wise selection of materials. In illustration of his judicial spirit we may refer to what is said about the estimation of the relative merits of co-operative discoverers. A generalisation gradually matures; many investigators may contribute to it; "when the time is ripe, some one with a better appreciation of the significance of the facts or a deeper insight into their mutual connection touches the matter with a master hand, and presents it in a form that carries conviction." Sometimes there is a long balancing of arguments for and against a new idea; he who adds the last grain that tips the balance is technically the discoverer. "There will always be a conflict between those who attach importance to the intrinsic merit of an investigation and those who look only on the actual influence it has had on scientific thought."

Dr. Shipley begins with the biological science of the Middle Ages; he sketches the development of botany in Britain from Turner to Ray, from Grew to Hales, from Knight to Brown, from Lindley to Hooker; he outlines the history of British zoology from Pennant and the Hunters to Owen and Huxley, from Erasmus Darwin to Charles Darwin, from Robert Chambers to Alfred Russel Wallace, and on to Balfour and Weldon, and to a master of the craft still with us, Sir E. Ray Lankester. A vivid sketch is given of the progress of physiology from Harvey and Hales to Michael Foster and Burdon Sanderson, and on to Wooldridge and Roy. The growth of geology sketched in the final chapter affords a crowning instance of the glory of the British heritage of science.

Dr. Shipley's story leaves one a little breathless, but this is because of the magnitude of his subject and the compulsory compression. His style is as vivid and delightful as ever; but we cannot approve of a construction like "the latter of whose work . . ." Some omissions strike us as curious; thus mention is made of four marine laboratories, but that at Millport, with the second largest record of researches, is left out; we find no mention of John Goodsir, whose work had far-reaching importance; and we are a little startled by finding no reference to the author of "The Principles of Biology." But we must not pursue the quest for omissions. Dr. Shipley makes some wise remarks on the limitations of science: "No body of scientific doctrine succeeds in describing in terms of laws of succession more than some limited set of stages of a natural process; the whole process—if, indeed, it can be regarded as a whole—must for ever be beyond the reach of scientific grasp. The earliest stage to which science has succeeded in tracing back any part of a sequence of phenomena itself constitutes a new problem for science, and that without end. There is always an earlier stage, and to an earliest we can never attain. The questions of origins concern the theologian, the metaphysician, perhaps the poet."

The authors have no thesis to establish, but their valuable book will leave in the minds of those who read it a strong impression of the large number of contributions of the first rank in importance that Britain has made to science, which is by its very nature cosmopolitan; and of the extent to which, in spite of our calamitous neglect, we are nationally indebted to science for advancement in mind, body, and estate. But we have not had more than the first-fruits.

(2) The aim of the second book is "to furnish a broad, general perspective of the evolution of science, to broaden and deepen the range of the students' interests, and to encourage the practice of discriminating scientific

reading." The authors believe that students will understand modern science better if they know more of its development, and we share this belief. Prof. Sedgwick is mainly responsible for the treatment of the "natural sciences"; Prof. Tyler for the mathematical. "The mathematical group, from their relatively greater age and higher development, afford the best examples of maturity; the natural sciences illustrate more clearly recent progress."

A considerable proportion of the volume—perhaps too much—is devoted to early history. In a very interesting way we are told of the gropings of the incipient scientific spirit in early civilisations, of early mathematics in Babylonia and Egypt, of beginnings in Greece and among the Ionian philosophers, of science in the Golden Age of Greece, of Alexandrian science, of science in the Roman world, and of Hindu and Arabian science. We are gradually led to the beginnings of modern natural science, which may be typified by the fundamental work of Galileo. The progress of the seventeenth century is illustrated by the work of men like Harvey, Boyle, Hales, and Huygens; the beginnings of modern mathematical science are found in Descartes, Newton, and Leibniz. The next chapter deals with the eighteenth century, and we read of Black, Cavendish, Priestley, Lavoisier, Scheele, and others in chemistry; the pioneers in the study of heat, light, sound, and electricity; the classifications of Linnæus, the descriptions of Buffon, the comparative anatomy of Hunter, the physiology of Haller, and so on. The story of the nineteenth century, all too short, is mainly concerned with the conception of energy, the rise of modern chemistry, and the development of genetic inquiries along many lines—geological, astronomical, biological, and anthropological.

There are some very interesting appendices, *e.g.* the oath of Hippocrates, the sixth part of the "Opus Majus" of Roger Bacon, the dedication Copernicus wrote to his "Revolutions of the Heavenly Bodies," Harvey's dedication of his work on the circulation, Galileo Galilei's condemnation and recantation, Newton's preface to the "Principia," and excerpts from Jenner and Lyell. There is a brief discussion of the origin of some inventions of the last two centuries. In a useful chronological list great names and dates in science are placed opposite great names and dates in general history and literature. And the volume ends with a selected list of reference books bearing on the history of science.

We appreciate the authors' scholarly and careful work, which will be of great value to serious students. The task attempted was perhaps too ambitious; for twenty authors, rather than two, would be required to show the true inwardness of the progress of scientific inquiry in its various departments. Sometimes the reader does not get enough material to enable him to understand the drift of the history; sometimes he will be apt to lose the wood in the trees. The success of the authors is most marked in the chapters dealing with early days, and in those sections where they have concentrated attention on the development of particular conceptions, such as energy or organic evolution. We like the frequent citation of typical passages from authorities, and we admire the solid competence of the whole work. There are some interesting illustrations, *e.g.* of Tycho Brahe's quadrant, Huygens's clock, and Newton's theory of the rainbow.

REFRIGERATION AND RELATED SUBJECTS.

La Statique des Fluides, la Liquéfaction des Gaz, et l'Industrie du Froid. By E.-H. Amagat and L. Décombe. Première Partie: *Statique des Fluides Purs.* By E.-H. Amagat and L. Décombe. Deuxième Partie: *La Problème de la Liquéfaction des Gaz, l'Industrie du Froid.* By L. Décombe. Pp. vi+265. (Paris and Liège: C. Béranger, 1917.) Price 18 francs.

THE first part of this book deals with the properties of liquids and gases, giving a very clear summary of some of the more important experimental work carried out in this branch of physico-chemical research. Amagat's work and conclusions are recorded in considerable detail, as well as much of the work of other physicists. The researches carried out by the great French physicist are of such importance that readers will be glad to have this connected account of them.

The compressibility of gases at different temperatures receives full consideration, and is illustrated by reproductions of the dpv/dp isothermals for ethylene, methane, carbon dioxide, air, and hydrogen. The curves for the last-mentioned gas are taken from the work of Onnes and Braak (1907) from $-180°$ C. to $-217°$ C., demonstrating that hydrogen at sufficiently low temperatures exhibits a minimum value for pv on the isothermals, as do other gases at higher temperatures. Van der Waal's equation, constituting an important advance with regard to our knowledge of the compressibility of gases, is given a prominent position in the book. The equations of Clausius, Sarrau, Amagat, and Onnes are briefly dealt with.

The application of the reduced equation of state (corresponding states) by Amagat to the determination of critical constants, by ascertaining the conditions of coincidence of the dpv/dp isothermals of different substances, is described in detail, and illustrated by superposition of the curves for carbon dioxide and ethylene, and carbon dioxide and ether. Leduc's work on molecular volumes in corresponding conditions receives attention, as well as the application of the method to the accurate determination of molecular and atomic weights. An interesting comparison of the results obtained for the atomic weights of a number of elements determined in this way with those obtained from density determinations shows that a high degree of accuracy obtains in most cases.

The study of refrigeration, dealt with in the second part of the book, opens with a brief account of the history of the liquefaction of gases. A chapter is devoted to the consideration of the essential parts of the Claude and Linde air liquefiers and the principles underlying their working. The Hampson liquefier is not described. The fractionation of liquid air is illustrated by diagrammatic representations of Linde's and Claude's fractionating plants, and the merits of the two systems are compared.

The theory of refrigeration is dealt with from the thermodynamic point of view, and a consideration of the expansion of gases against external pressure and without external pressure leads up to the behaviour of the working substance in a refrigerating machine. A comparison of ideal indicator diagrams of the cycle with those obtained in practice is utilised to bring out the points needing careful attention in work of this nature. The construction of the essential parts of refrigerating machines is described in some detail, and profusely illustrated with excellent reproductions. The book concludes with a chapter on the applications of refrigeration to ice-production, cold storage, and the preservation of foodstuffs, and a description is given of the construction of railway wagons and steamships designed for the transport of perishable foodstuffs.

On the whole, the subject-matter of the book is well thought out and presented to the reader in logical sequence and in a very lucid and readable form. The illustrations are numerous, well reproduced and explained, and deserve a special word of commendation. The bibliography in the second part of the book is fairly comprehensive, but the value of the first part might, perhaps, be enhanced by a little further attention to this point.

The utility of the book would be increased by the addition of an index.

A. G. G. LEONARD.

THE NERVOUS IMPULSE.

The Conduction of the Nervous Impulse. By Dr. Keith Lucas. Revised by E. D. Adrian. Pp. xi + 102. (Monographs of Physiology.) (London: Longmans, Green, and Co., 1917.) Price 5*s.* net.

IN the spring of 1914 Keith Lucas by good fortune was called upon to deliver the Page May memorial lectures at University College, London. He intended to rewrite the lectures for the present monograph, and by July, 1914, had completed eleven of the thirteen chapters. At the outbreak of war he offered his services to the country, and was posted to the Royal Aircraft Factory at Farnborough, where, until he was killed in an aeroplane accident on October 5, 1916, he was fully occupied with problems of flying. The two missing chapters have been written by Mr. Adrian, pupil and fellow-worker, for the most part from the lecture notes.

Nearly one hundred years of intensive investigation has been devoted to the nervous impulse. The volume of the work and the number of workers of outstanding ability who have engaged in attempts to discover the nature of a wave probably of no great intrinsic complexity may appear strange to a physicist. The reason is one of scale: the single conducting unit, the nerve-fibre, being only some 18 to 20 μ in diameter, is too delicate for separate treatment. It is necessary, therefore, to work with the nerve, which is a bundle of many hundreds of fibres. For this reason so simple a matter as the relation between the intensity of the stimulus and the amplitude of the wave is incapable of direct measurement, for it is impossible to determine directly whether an increase in the integral response of the nerve is due to an increase of the response of individual fibres or to an increase in the number of fibres called into action.

Owing to this ineradicable difficulty, the whole structure of our knowledge of the nervous impulse is based upon an assumption, namely, that the molecular wave suffers a decrement in traversing a region the conductivity of which has been impaired by some narcotic such as the vapour of alcohol, and that the capacity of the wave for traversing a narcotised region is a measure of its amplitude. The effect of this fundamental insecurity is, to quote Lucas's words, that "the argument of the experiments becomes somewhat complex. . . . The experiments are often easily made, even with a considerable degree of accuracy; it is in their interpretation that the real difficulty begins. And this difficulty arises again and again from the same cause, that nerves and muscles are not units, but each composed of many fibres."

What is the nature of the wave? It is accompanied by a change of electric potential, but as the rate of travel is only of the order of 40 ft. per sec., it cannot be a simple electrical wave. It is true that on Kelvin's cable theory and by making many assumptions it can be shown that a wave of simple displacement of electricity would travel in a structure like the nerve-fibre at a speed of this order. But by delicate microchemical technique it has been found possible to detect an increased output of carbon dioxide during the passage of the wave, and a rise of temperature has been measured of the order of 7×10^{-6} of a degree Centigrade, not to be accounted for save as heat liberated during the passage of the wave, which would therefore appear to be one of exothermic chemical change.

These and other cognate problems are discussed in the clear logical way so characteristic of Lucas's mind, and from these relatively simple issues the author proceeds to consider how far the phenomena of the isolated nerve may be used to interpret the much more complex phenomena of the central nervous system.

I commend the book to physicists—to the physiologist it is a matter of professional interest, but to the physicist it should come as a romance.

Of the gifted author himself there is no space to speak. His skill, his courage, his clear vision are fittingly dwelt upon in a prefatory note by Prof. Starling which could not be bettered.

W. B. HARDY.

OUR BOOKSHELF.

A Course in Food Analysis. By Dr. A. L. Winton. Pp. ix+252. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 7s. net.

This is a useful introductory work for students who have had preliminary instruction in general chemistry and are commencing to learn the principles of food analysis. The author has arranged his subject-matter in a manner suitable for class work during a course extending over forty laboratory periods of four hours each. In his experience multiple pieces of apparatus, such as Kjeldahl digestion and distilling stands, are most convenient when designed for twelve determinations—that is, for six students, each carrying out duplicate experiments; and the same number of students is also a convenient one to use on the same day such apparatus as the polariscope, refractometer, or Westphal balance. Hence in the text provision is made for students to work in groups of six, if so desired, and the methods can be suitably allotted to avoid duplication of expensive apparatus.

General information is given upon, and laboratory work mapped out for, the various classes of foodstuffs—dairy products, flesh foods, cereal foods, sugars, fats, vegetables, fruits, flavourings, and beverages. The general matter indicates the nature and composition of the foodstuff dealt with, and includes brief statements of the principles involved in the chief methods of analysis employed for examining it. In the laboratory work prescribed there are detailed instructions for carrying out the commoner estimations. These include experiments with the polarimeter, refractometer, tintometer, and colorimeter; nitrogen estimations; determinations of alcohol, saponification numbers, iodine values, and so forth. A useful chapter is one devoted to the microscopic examination of vegetable foods.

The book is written primarily for American students, but the English user will find no difficulty arising from that fact—except perhaps for an occasional phrase such as "Hamburg steak" or "salt-mouthed bottle." As an introduction to more comprehensive works the volume can be confidently recommended. C. S.

Instruments de Musique: Le Télharmonium. By Julien Rodet. Pp. 96. (Paris: Gauthier, Villars, et Cie, 1917.) Price 3.50 francs.

This little book is characteristic of the clear exposition of a well-informed French author when he has thoroughly mastered the subject. All the phenomena of sound are briefly dealt with in such a manner that he who runs may read. The chapters include the production and propagation of sound, a short discussion of the laws of vibration of cords, plates, and tubes, the intimate nature of musical sounds, and a study of musical scales. Then follows a summary description of the more common instruments of music; this chapter will be of great use to the amateur who desires to know the principles on which his favourite instrument is constructed. The last chapter is on a new instrument, the tel-harmonium, and is the novel part of the book; it is the description of an electric organ by which, and by electrical means alone, a synthesis is possible of any musical sound, however complex. The tones so produced are developed by telephone. Alternating currents produce electric generators of tone, and these are superposed on the diaphragm of a telephone. A keyboard controls the tones of seven generators, and by resistance arrangements the intensity of any generator may be modified. In this way it is said that the qualities of the chief instruments of the orchestra, such as the clarinet, the oboe, the cor anglais, the violoncello, and others, can be reproduced with such accuracy as to satisfy the musical sense of a musician who is unaware of the origin of the sounds. Evidently the manipulation of the instrument must be difficult. J. G. 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.]

Pope Innocent VIII. and Witchcraft.

In the issue of Nature for April 11, p. 113, is an erratum which corrects a statement made in Nature for April 4, p. 82, regarding Pope Innocent VII. and witchcraft. It is stated that Pope Innocent VIII. in 1484 "gave the sanction of the Church to the popular beliefs concerning witches." In the cause of historical truth it must be stated that Pope Innocent VIII., by his Bull "Summis desiderantes affectibus" (1484), must be considered to affirm the reality of the alleged phenomena of witchcraft. But the Bull pronounces no dogmatic decision, and the Pope does not wish anyone to believe more about the reality of witchcraft than is involved in the utterances of Holy Scripture. The immediate effects of the Bull have been greatly exaggerated. The expression, "gave the sanction of the Church," is, therefore, inexact, and, being inexact, is unscientific; it needs much qualification.

A. L. Cortie.

Stonyhurst College, April 18.

[The reference in Nature was from an article by Dr. E. Withington in "Studies in the History and Method of Science," reviewed in our issue of April 4. Dr. Withington sends the following remarks upon Father Cortie's letter.—Ed. Nature.]

The Pope's Bull is printed as preface to all editions of the "Malleus maleficarum." It was taken as authoritative by Catholic inquisitors, and, presumably, by most of the faithful. This is what ordinary English people would understand by "the sanction of the Church"; those who in future denied "the reality of the alleged phenomena of witchcraft" would contradict an affirmation of its supreme Pontiff.

The writer did not intend to suggest that such beliefs are current among Catholics of the present day or form part of Catholic dogma. E. Withington.

THE CENTENARIES OF GERHARDT AND WURTZ.

IT is surely a coincidence not without its special significance that, at the very time when France, with the sympathy of the greater part of the civilised world, is nobly struggling to regain the provinces of which she was despoiled nearly half a century ago, it should be her pious duty and peculiar privilege to celebrate the centenaries of two of her many eminent sons, both illustrious in the annals of chemical science, both Alsatians, and Frenchmen to their very finger-tips. These events, occurring under present conditions, we may be sure, have not failed to impress the soul of France, or to stimulate and strengthen her resolution to gather again within her fold those compatriots of whom a brutal and arrogant despotism had ruthlessly robbed her. Subjects of which Gerhardt and Wurtz are types are, indeed, among the most precious of her assets. In thus commemorating the services of these distinguished Alsatians, the Chemical Society of France has also expressed the sentiments of admiration and esteem with which those services are regarded wherever science is appreciated.

Charles Frederic Gerhardt was born at Strasburg on August 21, 1816, and died in that city on August 19, 1856. The son of a white-lead manufacturer at Hangenbieten, near Strasburg, it was the intention of his father that Gerhardt should assist him in his business, and with the object of learning chemistry he was sent, on leaving the Protestant gymnasium of his native place, first to the Polytechnic at Carlsruhe, and then to Leipzig, where he worked in Erdmann's laboratory. Here, when barely nineteen years of age, he made his first contribution to the literature of science—a lengthy paper in the *Journal für Praktische Chemie* on "The Formulæ of the Natural Silicates." He now returned to Hangenbieten, but the craft of chemical manufacturing had no attractions for him. He eventually threw up his position and enlisted in a cavalry regiment, from which, thanks to the generosity of Liebig, to whom he became in turn pupil, friend, and rival, he was enabled to procure his discharge. After a short stay at Giessen he made a second attempt to comply with his father's wishes. It was no more successful than the first, and, after eighteen months of irksome drudgery, he finally abandoned the effort and betook himself to Paris. Although only twenty-two, the venture was not altogether hopeless, for he had already made a mark in French scientific circles by his translation of Liebig's "Introduction to the Study of Chemistry," published by Mathias in 1837. The handsome, well-grown youth, almost feminine in features, was well received by Dumas, whose early experiences were not wholly dissimilar, and under his encouragement Gerhardt attached himself to the *Répertoire de Chimie*, then directed by Gaultier de Claubry.

On its foundation, in 1840, by Dr. Quesneville, Gerhardt joined the staff of the *Revue Scientifique*, and became one of the most active of the contributors to that famous periodical. The times were favourable to the development of his genius, and no field for the display of his peculiar talents could be better than that journal. Revolutions were impending not only in the political world, but also in that of science. It was, perhaps, the most pre-eminently polemical period in the history of chemistry—a time of Homeric combats between the opposing schools of France and Germany. Gerhardt, from his antecedents and upbringing, was well fitted to be what he actually became—a free-lance, whose keen and incisive thrusts were directed, with equal impartiality, sometimes at one protagonist and sometimes at the other. No wonder that the articles over the signature "Z" were eagerly scanned by both sets of combatants.

Space will not permit of any detailed examination of Gerhardt's powers as a critic. One example, however, may be given, which, although of minor importance, is typical of his skill in sarcasm. As is well known to chemists interested in the history of their science, the followers of Liebig were at first disposed to scoff at the doctrine of substitution, and the editor of the *Annalen* had disfigured his pages by a letter, supposed to emanate from Paris, and signed S. C. H. Windler, in which the writer, in execrable French, attempted a *reductio ad absurdum* of Dumas's great discovery. It was a somewhat clumsy piece of buffoonery, flavoured with that spice of malice which so frequently characterises what Germans regard as humour. Gerhardt took a neat revenge by reprinting the letter in the *Revue Scientifique* with all the solecisms, faults of grammar, and mistakes of idiom scored through or italicised, as if correcting a schoolboy's composition. The letter, as we now know, was written by Wöhler; it was unworthy of that calm and unimpassioned philosopher, and was, we may be sure, in after years regretted by him.

Whilst in Paris Gerhardt worked with Cahours, and after 1841 many of his papers appeared in the *Revue*, more especially on didactic subjects connected with chemical philosophy.

In 1841 he was appointed to succeed Balard at Montpellier, where he remained seven years. He continued to write for the *Revue*, but the results of his experimental work were, as a rule, sent to the Academy, and appeared in the *Annales de Chimie*. Almost at the outset of his career as a professor he was brought into conflict with Laurent, but the two men soon healed their differences, and to the great benefit of science and their own fame became firm friends and active co-workers until separated by Laurent's death in 1853.

In 1848 Gerhardt returned to Paris, where he learnt to know Williamson, who was at that time studying mathematics under Comte. He had started the *Comptes rendus des Travaux de Chimie* in 1845 in association with Laurent, presumably to afford its editors a wider and more independent scope for the dissemination of their peculiar views than was possible to them in the

Revue Scientifique. The journal had a somewhat chequered career; each year saw a change of publisher, and it ceased to appear in the troubled times of 1851. He now started a school of practical chemistry at 29 Rue M. le Prince, where he had as pupils and collaborators, amongst others, Chancel, Chiozza, Pisani, and for a time August Kekulé. It was here, too, that he made his memorable researches on the organic anhydrides—the culminating point of his experimental work. Shortly before his death, in 1856, at the age of forty, he was transferred to Strasburg, but beyond a couple of short papers published posthumously, nothing further appeared from his pen.

It would be impossible to do adequate justice, in an article of this kind, to the extraordinary value of Gerhardt's labours during the twenty short years of his ceaseless activity. His mind was continually at work upon the basic principles of theoretical chemistry, and his pen was never idle in expounding them. His wealth of ideas, the fruitfulness of his conceptions, his grasp, the range of his knowledge, and his logic and insight are simply astonishing. Much of his doctrine is now so woven into the structure of the science that to recall it all would seem to the student of to-day to savour of the commonplace. But what a catalogue it makes!—the reform of the atomic weights, the unification of formulæ, the true conception of the molecule and the atom, constitutional formulæ, the principle of homology, the *rôle* of water in chemical change, the basicity of acids, and the nature and classification of salts. Such is the baldest summary of Gerhardt's influence on the philosophy of chemistry, as expounded in his critical papers and his various text-books, above all in his classical treatise on organic chemistry. His published papers number more than 100, almost exclusively on subjects of organic chemistry—essential oils, the alkaloids, amides, anilides, ureides, thiocyanates, mellonides, and lastly the acid anhydrides—coextensive, in fact, with the whole range of that section of the science. The admirable biography which we owe to M. Grimaux and the filial piety of M. Charles Gerhardt, jun., does full justice to these imperishable labours, and they are recalled in graceful and felicitous terms in the *Conférence* which M. Marc Tiffeneau delivered before the Chemical Society of France on the centenary of the birth of their illustrious author.

Charles Adolphe Wurtz was born at Strasburg on November 26, 1817. He was the son of a Lutheran pastor in a small village near that city, and it was the intention of his father, who had inscribed his name at the Protestant seminary of theology, that he should follow his own profession. The boy, however, had been irresistibly attracted towards chemistry, and his inclination was strengthened by his association with Caillot, then professor at Strasburg, to whom eventually be became lecture-assistant. The father had little sympathy with the son's aspirations. In his judgment chemical science offered little or no prospect of a living, and accordingly the young Wurtz, to meet in some degree his parent's objections, applied himself to medicine and took his degree in that subject in 1843. In the course of his studies he repaired to Giessen, then the Mecca of chemists, and worked under Liebig for about a year. This circumstance determined his career. In 1844 he left Alsace to join Dumas, to whom he had been recommended by Liebig, and in the well-known laboratory in the Rue Cuvier he worked in company with Cahours, Melsens, Stas, Piria, and others, who became more or less eminent in that stirring and fruitful epoch.

Dumas's influence at that period was all-powerful in France, and Wurtz's rise was rapid. He was "chef des travaux chimiques" at the Ecole Centrale in 1845, and in 1846 a member of the Faculty of Medicine. When Dumas became Minister of Agriculture and Commerce, after the Revolution of 1848, Wurtz succeeded him as professor of organic chemistry, becoming titular professor of mineral chemistry in 1853 in succession to Orfila and a line of such illustrious ancestors as Fourcroy and Vauquelin. Here he remained for twenty-one years, attracting to himself a body of active workers from all parts of Europe and America by his power as a teacher, and by the enthusiastic energy with which he directed his school of research. In 1872 he was made professor of organic chemistry at the Sorbonne, a position created for him. He retired in 1882 and died on May 12, 1884.

During the half-century of Wurtz's scientific activity France passed through many political crises, which, no doubt, at times were not without influence on his position and prospects, but, on the whole, his career was far more placid and prosperous than that of his brilliant compatriot. Although practically contemporaries, Gerhardt was at the height of his fame when Wurtz was but little known outside Paris. To-day, indeed, the men seem to belong to a different age. By far the greater volume of Wurtz's work was published when Gerhardt had ceased to write. His earliest efforts were on inorganic subjects. He studied the acids of phosphorus and determined their basicities, which he afterwards confirmed by preparing their compound ethers; he discovered phosphoryl chloride and copper hydride, the first member of this class of substances to be made known, and noted the significance of the mode of its decomposition by hydrochloric acid in reference to the atomic constitution of elements in the free state.

But under the influence of Dumas he soon turned into the rapidly developing field of organic chemistry. His work on copper hydride led him to speculate on the constitution of Frankland's compound radicals, and to indicate the necessary existence of mixed radicals, such as methyl-ethyl, ethyl-amyl, etc. He discovered liquid cyanogen chloride and synthesised urethane, and prepared the cyanic and cyanuric ethers and the first of the compound ammonias—a subject brilliantly exploited by Hofmann a few years later. He prepared the compound ureas, established the triatomic character of glycerol, and predicted the existence of the diatomic alcohols, which he established by the discovery of glycol, glycollic acid, and a number of other derivatives. The theoretical deductions to which these researches gave rise led to a memorable controversy between the French and German schools, which greatly influenced the development of the conception of basicity, and the spread of Gerhardt's teaching of the true principles on which the formulation of organic compounds should be based.

In 1854 Wurtz isolated butyl alcohol (*iso*-propyl carbinol) from the fusel oil of potato-spirit, and ten years later he added another term to this series of homologues by the preparation of his methylene hydrate, an isomeride of amyl alcohol discovered by Cahours. The mode of its resolution by heat into water and amylene led Wurtz to the study of abnormal vapour densities, as manifested by the thermal decomposition of phosphorus pentachloride, the hydrate and alcoholate of chloral, ammonium sulphydrate and chloride, etc. —an inquiry which brought him into conflict with Berthelot and Sainte-Claire Deville. His study of the action of hydrochloric acid on aldehyde led to the discovery of aldol, its polymerides, and other derivatives, which occupied much of his attention for several years.

The foregoing is a very incomplete summary of Wurtz's contributions to experimental chemistry contained within some 150 memoirs. His relation to his epoch has already been set forth in the admirable obituary notice by Friedel—himself an Alsatian—which appears in the Bulletin of the Chemical Society of France—a society of which Wurtz was one of the original founders, and which he consistently supported so long as he lived. A charming sketch of his life, work, and personality by his pupil and life-long friend, Prof. Armand Gautier, appeared in the *Revue Scientifique* of December 22–29, 1917, written on the occasion of the celebration of his centenary. It affords a delightful picture of Wurtz as he appeared in his laboratory—the directing and dominant agency, *primus inter pares*, of a galaxy of collaborators such as Friedel, Caventou, Crafts, Louguinine, De Clermont, Salet, Naquet, Willm, Oppenheim, Lauth, Girard, Le Bel, Grimaux, Cleve, Chydenius, Tollens, Sell, Silva, Henninger, Maxwell Simpson, Hanriot, Franchimont, Œchsner de Coninck, Richet, and van't Hoff, with Gautier himself—all men who, stimulated by the example of their leader and influenced by his teaching, have contributed to fashion the edifice of modern chemistry.

Wurtz was a fine character—a man with a broad mind in a large and manly frame. He had all the qualities which attract men and fascinate youth—charm of manner, transparent integrity, generous impulses and a ready sympathy, an enthusiastic and loyal devotion to science, and a quick and whole-hearted appreciation of merit in those who sought to enlarge its boundaries. He was idolised by his students. As a lecturer he had much of the force and fire of his master, Dumas, the same gift of happy and graceful diction, the same clarity of thought, the same power of logical and lucid exposition. He had also, in no small measure, Dumas's facility of literary expression. No nobler tribute was ever penned than that paid by Wurtz, in the opening pages of his well-known *Dictionnaire*, to the genius and labours of Gerhardt and Laurent. M. Armand Gautier well applies to him the words which he himself used at the graveside of Dumas: "Votre grande figure n'est pas de celles qui puissent disparaître dans l'oubli. Votre souvenir se perpétuera, votre nom passera d'âge en âge. Vous vivrez par vos œuvres, par l'exemple que vous avez donné, par les productions immortelles et les qualités de votre esprit."

T. E. THORPE.

ICE AND FLOWER EXPLORATION IN HIGH ASIA.[1]

(1) THE indefatigable explorers of the glaciers of the Karakoram Himalayas, Dr. and Mrs. Workman, who have done more than any others to visit and map out the details of those vast ice-fields, give in the volume before us still another account of their travels and explorations in a new sector of these regions. As usual, in order to cover as much new ground as possible within the narrow summer limits in which travel was practicable, they formed separate and independent expeditions, although they combine their results in a single volume. At the present time, when so much is being written about the extension of women's sphere on account of the war, it is interesting to find abundant evidence here of the *pre-war* exploits of a woman-pioneer in these Indian Alps, in fields usually regarded as the especial preserve of men, and of men of unusual nerve because of the physical perils to be encountered and overcome.

Mrs. Workman independently instituted and led the pioneer expedition to the hitherto unvisited Rose Glacier of Sia Chen, which is the longest non-polar glacier in the world; Dr. Workman explored the Sher-pi-Gang and other glaciers and basins; and between them they achieved the feat during two summers of mapping out nearly two thousand square miles of ice-field details for the first time. Although the journeys were performed in 1911 and 1912, the exigencies of the war have prevented the publication before now; but as no one else has visited those regions since then, this delay in no way detracts from the interest and solid scientific value of the work accomplished and now given to the public.

A striking feature of the moraines in those remote regions was the great preponderance in them of sedimentary rocks at such an extreme altitude. The "black" moraines on the north, which must have been intensified in the snowy surroundings, were found to consist of hardened black shale and mixed with slabs of "a pure white

[1] (1) "Two Summers in the Ice-wilds of Eastern Karakoram: The Exploration of Nineteen Hundred Square Miles of Mountain and Glacier." By F. B. Workman and W. H. Workman. Pp. 296. (London: T. Fisher Unwin, Ltd., 1917.) Price 1*l*. 5*s*. net.

(2) "On the Eaves of the World." By Reginald Farrer. Vol. i., pp. xii+311; Vol. ii., pp. viii+328. (London: Edward Arnold 1917. Price, 2 vols. 30*s*. net.

marble"; and on the south the black slaty sedimentary rocks contained some veins of iron pyrites with quartz and other igneous rocks.

As in their previous joint books, the text is enriched by a profusion of excellent photographs, all taken by the writers themselves, and quite up to the high standard set in their earlier journals. Altogether, it is an attractive record of solid geographical achievement.

(2) This is one of the travel-books which owe their existence to the enterprise of horticulturists ransacking the world for new species of flowering plants for decorative garden purposes. The recesses of south-western China have already proved a happy hunting-ground for such botanical expeditions, especially in the more southern borders, but our author traversed the unfrequented northern portion in the hope of securing new specimens which would be more hardy and thus more suitable for the British climate than the softer productions of Yunnan and Szechuan, which have now been freely explored by Forrest and other collectors. The narrative, in detailing the author's experiences, reflects his abounding enthusiasm; and though he has his eyes mainly on the business of collecting, he also gives incidentally a good deal of description of the people and of the country through which he passes. As it makes no pretence of being a scientific book, and is thoroughly colloquial in style, relatively free from technicalities except the names of plants, and somewhat facetious, it is easy reading for the general reader. The author had some excitement at times in evading the roving bands of brigands on the Tibetan border called the White Wolves. He prefers his own system of phonetics for Chinese names: thus Archueh becomes "Arjeri," and the familiar Yamen appears as "Yamun."

With Mr. Purdom, formerly of Kew, and three Chinese lads, Mr. Farrer started from Peking in the spring of 1914 and spent that year on the hill ranges of South Kansu on the border of Tibet, and thereafter wintered in the north, moving farther north in 1915 into the alpine tracts above Sining. Those tracts had previously been in part traversed rapidly by the scientific expeditions of Prezewalsky and Potanin, but these brought back only dried specimens, and did not gather seeds or living plants, which defect our author has now remedied for cultural purposes in regard to several rare species. A list of the new species is given in the appendix, and includes amongst others several new poppies, primulas, and asters, a new gentian, and two new rhododendrons, besides the Isopyrum named after the author, which is here illustrated. Several others of the new species are also decidedly decorative, as seen in good photographic reproductions, whilst other photographs illustrate some of the country traversed and its semi-Tibetan people.

L. A. WADDELL.

FIG. 1.—*Isopyrum Farreri*, sp.n. From "On the Eaves of the World."

THE SUN AND THE WEATHER.

PROF. C. G. ABBOT has contributed to the *Scientific Monthly* (November, 1917) a reasoned discussion, in the light of recent investigations, of the extent and probable sequence of the effect of solar variation on world weather.

More than one independent line of argument will be found to point to the conclusion that in a period of two thousand years there has been no appreciable change of climate. Therefore the balance of the heat exchanges between the earth's income from the solar radiation and its expenditure in terrestrial radiation into space may be regarded as only fluctuating between narrow limits. Eighty per cent. of the solar radiation fails to reach the earth's surface through its protecting envelopes, and 90 per cent. of the terrestrial radiation fails to escape. Such is the beneficent effect of our atmosphere, for want of which the temperature of the moon's surface, as proved by actual observation, falls during the short period of a lunar eclipse many times as far as does that of any part of the earth between day and night. In most places on the earth the surface air temperature rarely varies as much as 1 per cent. from day to day, but the variation between day and night is affected by the character of the surface, Timbuktu, in the Sahara desert, having twice the daily and four times the annual change of temperature at Port au Prince, Haiti, in approximately the same latitude.

Prof. Abbot considers that a slow increase of 1 per cent. in solar radiation should produce a change of 1 per cent. in terrestrial radiation, and on the assumption that this varies as the fourth power of the absolute temperature, he finds this to be equivalent to a change of 0·7° C. for each unit per cent. of change of the solar radiation. The annual change of mean temperature at Timbuktu on this account should be 24° C., but is actually only 13·6° C. From this Prof. Abbot concludes that the annual variation (due to the sun's changing altitude) is not slow enough to produce its full effect, and suggests that the variation in the period of the sun-spot cycle may be more effective.

Dr. G. T. Walker finds in general a lower temperature at sun-spot maximum, and this is confirmed numerically. Köppen, for instance, finds at sun-spot maximum an average decrease of 0·7° C. for the period 1815–73, and of 0·5° C. for the period 1873–1910, when the maxima were, on the average, less intense. This apparent paradox is tentatively attributed to increased cloudiness, possibly due to greater penetrative power of the solar ions. Prof. Abbot's short-period fluctuations in the solar radiation provide another line of approach to the elucidation of the problem, and Dr. Clayton, of Argentina, has applied the method of correlation, for about fifty well-distributed stations, between Mount Wilson solar constant values and local changes of temperature for the few following days, obtaining in some cases significant coefficients. Thus an increase of solar radiation was followed by an increase of temperature at Pilar, Argentina, with its maximum one or two days late, and by a decrease at San Diego, California, with its maximum three or four days late. In the temperate zones, roughly speaking, the correlation is negative, and elsewhere positive, but the tropical belt of positive correlation is narrower over the oceans. The amount of the change found by Dr. Clayton is several times larger than Prof. Abbot's reasoning led him to expect. He therefore concludes that the results require confirmation, but that they indicate secondary processes set going in the atmosphere by changes in solar radiation, and that the effect on winds, cloudiness, and precipitation may be revealed. He infers that as the changes in the sun are followed by changes of similar magnitude on the earth, with a lag depending on latitude, these changes could be predicted if we can secure daily observation of the solar emission. For this purpose new observing stations in cloudless regions are required, and considerations of expense will probably defer this until after the war. Prof. Abbot hints finally that a bequest of half a million dollars would enable the Smithsonian Institution to handle the problem adequately. W. W. B.

ANTI-VIVISECTIONISTS AND PROTECTIVE MEDICINE IN THE ARMY.

It is wonderful to what follies anti-vivisection will betray those who believe in it. The American Red Cross has been involved in a lawsuit by some of the American anti-vivisectionists, who are endeavouring to prevent it from doing medical research on active service. This research would be, almost all of it, bacteriological; it would be inoculations of small rodents in the direct course of the work of the Red Cross for the Army; but the anti-vivisectionists seem to care more for the rodents than for the Army. Dr. W. W. Keen, of Philadelphia, one of the very foremost of American surgeons, whose name is well known among our own physicians and surgeons, has written an admirable article in *Science* of February 22 last on this attempt to interfere with the work of the Red Cross. He tells again some of the oft-told truths: the facts of the protective treatment against typhoid, of the protective treatment against tetanus, of the results of Lister's work, and so forth. He points out that the anti-vivisectionists in his country all these many years have done nothing, absolutely nothing, to lessen disease or to save life either in animals or in man; and he quotes the statement made by forty-one American medical officers on active service in France: "We feel that anyone endeavouring to stop the Red Cross from assisting in its humanitarian and humane desire to prevent American soldiers from being diseased, and protecting them by solving the peculiar new problems of disease with which the Army is confronted, is in reality giving aid and comfort to the enemy."

This article by Dr. Keen is well worth studying; but some anti-vivisectionists are blind and cruel; and it is not possible to reason with them, any more than Antonio could argue with Shylock. The fact is that the anti-vivisectionists, since the War, have been rather out of work; and, as Dr. Watts says, "Satan finds some mischief still for idle hands to do."

Over here they have done, since 1914, very little. Some of them led a wild campaign against the protective treatment of our soldiers against typhoid fever; but nothing worthy of notice came of it. Attempts have also been made lately to use the memory of Miss Nightingale as a sort of stalking-horse for anti-vivisection, and to persuade this nation that Pasteur and Lister were of little worth. Over these and the like vagaries, anti-vivisection is spending its time and its money, hoping, after the war, to recover hold of public attention. Surely it will be disappointed of that hope. The war has burned deep into the hearts of all of us this lesson, that the magnificent work of our Army medical services is indeed founded and built on knowledge made possible by experimental bacteriology. Not all the anti-vivisection societies in the world will ever persuade us to forget that lesson of the war.

NOTES.

SOME little excitement was caused in agricultural circles by an article in the *Times* of April 20 describing how to grow wheat and grass on the same land. The method, if well founded, would revolutionise agriculture and overcome some great difficulties in food production. At present it is impossible to express any opinion, as no sufficient statement of detail has yet been made. It was stated in the article that the Government experts had been much impressed by the method, but inquiries at the Food Production Department put rather a different complexion on the case. According to the article, the method consists in delivering a mixture of wheat- or oat-seed and artificial fertilisers under the surface of grass land in July. By September or October the cereal is stated to have grown from 8 in. to 10 in. high. Livestock are then run on to the field to eat down the corn and grass; the effect of this is said to be a strengthening of root-growth. The protection from frost given to the roots of the cereal by the covering of turf is further said to cause an earlier start of normal spring growth, more heads to be thrown up, more rapid development of the plant, and earlier ripening of the grain. The harvesting is proposed to be done by means of an ordinary mowing machine fitted with an extra knife at the proper height above the grass to cut the heads of the grain. The lower knife is to cut the hay as usual, and the upper knife to act as a "header." Special arrangements are proposed for separately collecting the grain and the straw. It would be easy to enlarge on the advantages of the method if it materialised, but expectations should be repressed until a definite trial has been made and seen by competent observers. Agricultural experiments are just as full of pitfalls as any others, and agricultural literature contains many proposals for revolutionising crop production which, unfortunately, never matured. There is a great deal of evidence to show that growing grass has a pernicious effect on wheat sown in the ordinary way, as careless farmers have often learned to their cost. Mr. Pickering's experiments at the Woburn Fruit Farm further demonstrate the incompatibility of grass and crops. It will be well, therefore, to await definite and unexceptionable evidence before attaching importance to the new claims, which are the subject of a further article in the *Times* of May 1.

A BILL entitled "Coinage (Decimal System)" has been introduced in the House of Lords by Lord Southwark. The measure provides that for the existing coinage of silver, copper, and bronze there shall be substituted a decimal coinage based on the sovereign. All coins below a sovereign are to be multiples of the thousandth part of a sovereign, such part being also minted and called a "mil." The new coinage specified in the schedule to the Bill includes silver coins of the double florin (200 mils), florin, half-florin, and quarter-florin; coins of nickel, or other metal or alloy, of ten mils and five mils; and bronze coins of four, three, two, and one mil. There is a provision to the effect that in the case of any statutory undertaking authorised to levy or demand rates, tolls, charges, or payments the Board of Trade may, on application, fix the amount to be payable in mils in respect of any such authorised rates, etc. If the measure becomes law, the date on which it is to come into operation will be fixed by proclamation. It will be noticed that the proposed legislation closely follows the suggestions put forward by the Decimal Association, which were referred to in NATURE of October 18 last (p. 132). The proposed bronze coins represent very approximately our present penny, halfpenny, and farthing, while, in addition, there is a coin of three mils which is nearly three farthings. This large range of coins of low denominations would probably be found convenient in the equitable adjustment of prices of commodities. The adoption of a decimal coinage has for some years been advocated by bodies representing banking and other commercial interests; and the decimal subdivision of the currency would certainly facilitate accounting work.

ABOUT five-and-twenty cases of a disease believed to be botulism have recently occurred in London and Sheffield. After an incubation period of from twelve to twenty-four hours the disease sets in acutely with paralysis of the internal and external muscles of the eye, dilatation of the pupil, vomiting, arrest usually of the salivary secretion, difficulty of swallowing and loss of voice, and depression of the heart's action, which may cause a fatal issue. The condition is due to a poison found in food by the action of a bacillus, the *B. botulinus*, which chiefly occurs in tinned food, ham, and sausages; from the last-named the name is derived (Latin, *botulus*=a sausage). So far the *B. botulinus* has not been isolated in connection with the present series of cases, and until this is accomplished its exact nature must remain somewhat doubtful.

THE Faraday Society has arranged a general discussion on "The Co-ordination of Scientific Publication," to be held on Tuesday, May 7, at 5.30, in the rooms of the Chemical Society, Burlington House. The discussion, which will be of an informal character, will be opened by Sir Robert Hadfield, Bart., president of the society.

IN reply to a letter addressed to the Board of Trade on the subject of the Lighting, Heating, and Power Order, 1918, the registrar of the Institute of Chemistry has been informed that, "where consulting analytical research and technological chemists and teachers and professors of chemistry are able to show that by reason of their professional needs they have been unable to effect the economy prescribed by the Order, the Board will accept this as a sufficient explanation under paragraph 14 of the Order."

AT the meeting of the Zoological Society of London on April 23, the secretary, Dr. P. Chalmers Mitchell, directed attention to an advertisement that recently appeared in the London Press announcing fur sales by public auction about to be held in the United States. The sales in question are only examples of what take place annually in London and other important commercial centres. The numbers advertised are smaller than usual, no doubt on account of the war, but they include very large quantities of animals the extinction of which cannot be far distant, unless measures are carried out to protect them. In the opinion of Dr. Chalmers Mitchell, which was confirmed by the meeting, there is urgent need for drastic measures to protect mammals. The protection of birds appeals to popular sentiment, and is zealously advocated by many influential organisations. The danger that threatens mammals is even greater, and, on account of their higher intelligence and more sensitive nervous organisation, the cruelty involved in the methods of hunting, trapping, and killing them is incomparably greater.

A FOOD economy (plants) exhibit has been installed in a new case in the Central Hall of the Natural History Museum. The several sections of the exhibit comprise cereals, bread, roots and tubers and other "vegetables," nuts, the pulses, fresh fruits, beverages, and sugar and its substitutes. The plants are those most generally used in the United Kingdom for foodstuffs, and these are shown by specimens, models, drawings, and diagrams. A feature of the exhibit is the series of coloured diagrams showing the values of some typical foods in energy and in building power; comparison of the food-values of different foods is easy, as all the diagrams are on the same scale and each colour has the same significance throughout. Two interesting items appear in the bread section: one is a model of a 2-lb. loaf, the thickness of the several daily rations being indicated by black lines; the other is an analysis of 4 oz. of bread with the actual constituents of a piece of bread of this weight. Food equivalents are exemplified in another part of the case by a series of samples of foods, all of them being equal in energy-value to the 4 oz. of bread.

IN the issue of *Le Génie Civil* for April 20 M. Nicolas Flamel, a French authority, continues the discussion of the German long-range gun. Interesting information is given regarding the type of gun, powder, shell, etc. It appears that the Germans have taken one of their 15-in. naval guns and, by means of the technical process known as relining, reduced the calibre to 8·2 in. The powder is probably an ordinary slow-burning powder, the weight of the charge being increased to give the desired muzzle velocity to the gun. The shell is in two parts, the special fine-pointed head and the body. The shell has special driving bands turned on projecting portions of the body, in addition to the usual copper bands. The burster is either T.N.T. or trinitroanisol (an explosive similar to T.N.T., but having a lower melting-point). The writer of the article does not incline to the theory of a special propellant shell, but thinks the gun has been produced in accordance with the usual practice, with necessary modifications in charge, shape of shell, and other minor details.

AN extraordinary general meeting of the Institute of Chemistry was held at King's College, London, on April 27, to consider matters submitted to the institute by the Executive Committee of the proposed British Association of Chemists, having in view the desirability of effecting the more complete organisation of properly trained and competent chemists. Several resolutions were passed, among them being :—(1) That it is desirable that the council should modify the existing requirements of the institute, in order to include as many chemists as possible in the membership (associateship and fellowship) of the institute, so far as such a course is within the provisions of the royal charter of the institute. (2) That, until December 31, 1921, it is desirable that any candidate who can produce evidence satisfactory to the council of having had a sufficient general and scientific education, and of having practised pure and applied chemistry for not less than seven years, and who holds a responsible position, should be accepted as eligible to apply for admission to the associateship of the institute, provided that he has complied with the provisions of the charter of the institute with regard to age, general education, and scientific training—in chemistry, physics, mathematics, and an optional subject—and that he has passed approved examinations in those subjects. It is the intention of the council to maintain the requirements for fellowship at a decidedly high level. Every associate will be required to produce evidence that since his admission and for a period of three years therefrom he has been continuously engaged in the study and practice of chemistry in a manner satisfactory to the council; and that he has carried out original research of sufficient merit in the opinion of the council, or that he has devised processes or inventions of sufficient merit in the opinion of the council, or, in special circumstances, that he is possessed of knowledge and ability equivalent, in the opinion of the council, to having fulfilled certain specified conditions, otherwise an examination will be imposed. Steps will be taken towards closer co-operation between the work of the institute and that of the universities and colleges; the question of extending the publications of the institute will be reviewed; further endeavours will be made to bring before the public the importance of chemistry to the country, and generally to forward the interests of chemists in every way possible.

MR. SAMUEL HENRY MILLER was a native of Fenland, and lived during the greater part of his life at Wisbech and Lowestoft. Elected a fellow of the Meteorological Society so long ago as 1870, he contributed several papers to its publications, dealing chiefly with observational meteorology, in which he was keenly interested. From 1861–76 he maintained a fully equipped meteorological station at Wisbech, and from 1879–1900 at Lowestoft. An important work by him, written in conjunction with S. B. J. Skertchly and others, is "The Fenland: Past and Present" (1878), in which the principal characteristics of this famous and interesting district are efficiently described. Other works written at that time are "A Guide to the Fenlands" and "The Camp of Refuge." A record of the gales experienced round the British coasts was contributed to *The Shipwrecked Mariner* in 1887. Mr. Miller was a gold medallist and foreign member of the Society of Arts and Sciences, Utrecht, and a fellow of the Royal Astronomical Society for nearly forty years. He left Lowestoft in 1900, and spent the remainder of his life in quiet retirement at Deal, where he was buried on April 20 at the advanced age of ninety-four years.

DR. J. MICHELL CLARKE, whose death occurred at Looe, in Cornwall, on April 21, was Pro-Vice-Chancellor and professor of medicine in the University of Bristol. He was a son of the late Mr. W. Michell Clarke, of Clifton, and was educated at Dr. C. T. Hudson's school at Clifton, Clifton College, Caius College, Cambridge, Bristol Medical School, and St. Thomas's Hospital. He took the M.B. degree at Cambridge in 1885, M.D. in 1892, and became F.R.C.P. (Lond.) in 1896. At Cambridge he favoured anatomy, in which subject he held a junior demonstratorship, but experience of clinical work soon convinced him that his true vocation lay on the medical side. In London he became house physician at St. Thomas's, and on returning to Clifton settled down as a physician. Dr. Clarke acted as lecturer on practical physiology, and later on as professor of pathology, in the Bristol Medical School; in 1907 he became senior physician to the Bristol General Hospital. He held a position of considerable influence, and was one of those chiefly concerned in the establishment of Winsley Sanatorium. Much of Dr. Clarke's scientific work was concerned with the welfare of his patients, and the list of his formal published writings is less extensive than might have been expected, though this is compensated for by the contributions, often of immediate utility, which he made to the medical journals. Amongst his writings may be mentioned "Hysteria and Neurasthenia," "Family Periodic Paralysis," "Spinal Cord Degenerations in Anæmia," and contributions to Quain's "Dictionary" and Allbutt's "System of Medicine." In 1915 he held the Bradshaw lectureship, and last year he was elected a member of the council of the Royal College of Physicians.

DR. A. H. CARTER, whose death occurred at his residence at Abingdon on April 1, was well known in Birmingham as a distinguished physician and an enthusiastic advocate of public and social work affecting the community of that great industrial centre. He was born at Pewsey, Wiltshire, and educated at Epsom College and University College, London, where his career as a student was marked by many distinctions, including gold medals in comparative anatomy, forensic medicine, and clinical medicine, also with silver medals in physiology and practical physiology. Dr. Carter took the degree of M.B. at the University of London, gaining first-class honours in physiology. In 1871 he was appointed house surgeon to the General Hospital, Wolverhampton, and two years later became pathologist at the General Hospital, Birmingham, afterwards as house physician, taking his M.D. degree in 1872. In 1876 he became a member of the Royal College of Physicians, and was elected a fellow of the college in 1881. Afterwards he was appointed physician to the Queen's Hospital, Birmingham, and became professor of medicine at Mason College, and later held the same office at the newly constituted University. Thus he was closely connected with the cause of medical education in Birmingham, and actively promoted the growth of the medical school in its affiliation to the University from Mason College. Dr. Carter's writings were mainly of a professional kind. In 1895 he published a text-book on the practice of medicine, which has reached the eighth edition. As president of the Birmingham branch of the British Medical Association in 1895 he gave an interesting address on "Rationalism in the Study and Practice of Medicine."

WE have received the seventy-eighth annual report (for 1917) of the Crichton Royal Institution, Dumfries. The physician-superintendent, Dr. Easterbrook, contributes a general account of the activities of this mental hospital. The causes of illness among the admissions for the year showed a decline due to alcoholism, but an increase due to venereal diseases. Results of ten years' treatment are discussed: the recovery rate is 35 per cent. among the certificated, and 46 per cent. among the voluntary, patients. Various experiments on potato-growing, cattle-breeding, and cattle-feeding have been carried out at the farm. The pathological research laboratory has been closed owing to the absence of the pathologist, Dr. Cruickshank, on war work. Notes on meteorological observations and data are included.

STUDENTS of animal behaviour will find some interesting facts on the "drumming" of the ruffed grouse (*Bonasa umbellatus*) in *Forest and Stream* for April, illustrated by a series of remarkable photographs, probably the first of the kind which have ever been taken. The author, Mr. F. K. Vreeland, had the good fortune to watch at close range one of these birds while "displaying," and he is convinced that the strange drumming sound then made is produced by the use of the wings alone. This may indeed be the case, but we suspect that later investigations will show that these sounds are at least partly vocal. The dissection of the syrinx would afford valuable evidence on this point. The author is apparently so much of an "outdoor naturalist" that he has never read any of the voluminous literature on this theme of courtship displays. But in some respects this adds rather than detracts from the value of his observations, since his records are made without bias.

THE deplorable results which are likely to accrue from hasty war-time legislation in regard to the Wild Birds' Protection Acts and game laws, in response to popular demand, are briefly commented upon in the *Scottish Naturalist* for April by Mr. Hugh S. Gladstone. The vindictiveness displayed towards the pheasant, he points out, is by no means justified. On overstocked estates these birds are certainly harmful to the farmer, but where the head of game is proportionate to the size of the estate they perform most useful work in clearing the ground of wireworm. It is certainly remarkable that, while we are severely penalising all kinds of "game," the French Government is making inquiries as to how best to restock the devastated area of the war-zone with partridges and hares. "It is to be hoped," Mr. Gladstone remarks, "that at no distant date there may be set up in this country an ornithological bureau similar to that already in existence in the United States."

IT is seldom realised that almost one-third of the continental part of Canada, or nearly a million square miles, must be regarded as unexplored. This is the estimate of Mr. C. Camsell, who has published in the *Geographical Review* for March (vol. v., No. 3) a map showing the location of the unexplored areas. In the same issue Mr. Camsell has a paper on some of the geographical problems awaiting solution in northern Canada. Recent discoveries have added more than 2000 square miles to the area of the Great Slave Lake, but few of its shores are yet surveyed. The Caribou Plateau, north of the Peace River, is a great unknown area, although it lies within easy access of settled regions. An even larger unexplored area lies north of Lake Athabaska, around the headwaters of the Thelon and Taltson rivers. On all sides of Hudson Bay there are huge areas which no white traveller is recorded to have crossed.

La Nature for April 6 describes a new form of voltaic cell, with electrodes of zinc and carbon in a solution of sal-ammoniac, which is due to M. Féry, and has been in use for some time on two of the French railways. The negative electrode is a plate of zinc which rests on the bottom of the glass containing-jar, the copper wire connected to it being insulated up to a point well above the level of the solution in the jar. The positive electrode is a carbon tube of diameter about half that of the jar, pierced with holes, which rests on the zinc plate, being insulated from it by an ebonite cross. The evaporation of the sal-ammoniac solution is retarded by the wooden cover. During the action of the cell the lower part of the solution becomes acid owing to the descent of the dense zinc chloride, while the upper part becomes alkaline owing to the ammonia produced. The depolarisation of the cell is effected by the air alone.

The electromotive force of the cell is 1·18 volts, and a cell giving 90 ampere-hours weighs only 2·1 kilograms.

THE work begun by Pollok and Leonard in 1905, on the spectrographic determination of metallic elements when present in solution in small quantities, has lately been extended to lithium, rubidium, cæsium, and gold by Messrs. A. G. G. Leonard and P. Whelan. The results are stated in a paper which appears in the Scientific Proceedings of the Royal Dublin Society, vol. xv. (N.S.), No. 25. In each case solutions of various strengths down to 0·001 per cent. were examined, and the tables show the relative persistency of the various lines as the concentration was diminished, thus providing a basis for quantitative analysis. Lithium and cæsium could be detected in 0·001 per cent. solutions, but rubidium and gold showed no lines in solutions of strength less than 0·1 per cent. Some of the photographs are reproduced, but, in the absence of a scale, comparison with the tables is somewhat difficult. A line at 2478 in the spectra of metallic lithium and rubidium, which the authors were unable to identify, was probably due to an impurity of carbon.

WE have examined a new astronomical model designed for use in schools and colleges by Dr. William Wilson. Those who saw the model at the Royal Astronomical Society last year must have been struck by its educational value, and will welcome the announcement that copies of it are to be placed on the market after the war, the matter of price being left for determination later. The model represents, with correct relative angular velocities and axial poses, the rotational and revolutionary movements of sun, earth, and moon, and the changes in the moon's orbit plane. Clockwork and cog-wheels are not employed, the movements being effected by taut endless strings passing over pulleys; each string has a tension regulator, easily adjusted to give the necessary tension. By slackening some of the tensions the corresponding movements are put out of action, so that the student can study simple cases, such as a planet revolving without rotation or a moon moving in the same plane as its primary. Fine adjustments are obtainable by slight alteration of the distance between the two half-discs into which the pulleys are divided; thus the severe test of the Saros eclipse cycle of 18 years 11 days was shown to be satisfied within a very small quantity; so the machine is not a mere toy, but is capable of giving graphical solutions of problems. The phases of the moon are shown by covering half of the white lunar globe by a black cap, which always keeps on the side opposite to the sun. Cones of different lengths can also be put on the moon to represent its shadow, and the production of total or annular solar eclipses. As Prof. Eddington has pointed out, the chief difficulty experienced by astronomical students is generally that of picturing relations that cannot be represented on a plane surface, but involve three dimensions. For such the model should prove very helpful. Full particulars of the model are given in an illustrated pamphlet to be obtained (post free 6d.) from Dr. Wilson, 43 Fellows Road, London, N.W.3.

WE have received a copy of a recent publication of the United States Bureau of Standards (Circular 67), entitled "Combined Table of Sizes in the Principal Wire Gages." This table includes the numbers and sizes in the following systems of wire gauges: American B. and S. (Brown and Sharpe), Steel (Stl.W.G.—known under the various names "Washburn and Moen," "Roebling," "American Steel and Wire Co."), Birmingham (Stubs'), British legal standard, and Metric. It gives the diameters of all the gauge numbers in these five systems in mils, inches, and millimetres, also the cross-sections in square mils, circular mils, square inches, and square millimetres. The table will probably be found useful by manufacturers who wish to determine the nearest equivalent in American or British sizes of wires, specified in millimetres or square millimetres, or *vice versa*. It should be noticed that the Stubs' Birmingham gauge is not the same as the series of sizes legalised in the United Kingdom in 1914 under the denomination "Birmingham gauge (B.G.)." The latter system is practically identical with the series of numbers and sizes issued by the South Staffordshire Ironmasters' Association in 1884, and is chiefly used for sheet and hoop iron and steel; but it is quite different from the legal American system ("Standard Gage for Sheet and Plate Iron and Steel," Bureau Circular No. 18). It is an excellent idea to issue in a handy form lists of the principal wire-gauge systems of America and the United Kingdom, and this table is likely to have a wide sphere of utility. A copy may be obtained on application to the Bureau of Standards, Washington, D.C., U.S.A.

THE tendency to utilise drop stampings has become very marked in recent years, and the advantages of these substitutes for forgings and castings have led to considerable developments in connection with munitions. Of the two chief methods of lifting the stamp steam is the older, but friction lifting is becoming more popular. Until recently the heaviest weight of tup and die dealt with by friction was about five tons, of which the tup weighed four tons. Messrs. B. and S. Massey, of Manchester, have now built two stamps capable of dealing with weights up to 9·5 tons, and these machines form the subject of an illustrated article in the *Engineer* for April 19. The stroke of the tup is 7 ft., and the lifting speed is 320 ft. per minute. Power is supplied by a 200-h.p. electric motor. The lifting mechanism consists essentially of a heavy clutch operated through a light relay clutch. The connection between the lifter and tup is made with strong woven belting 15 in. wide. When the tup is held suspended, the power delivered by the motor is dissipated in work done against friction and converted into heat; hence the necessity arises for cooling the clutch by circulating water, which in these machines is maintained in circulation by means of a pump.

AMONG the announcements of forthcoming books of science we notice the following:—"Tidal Lands: A Study of Shore Problems," A. E. Carey and Prof. F. W. Oliver (*Blackie and Son, Ltd.*); "The Production and Treatment of Vegetable Oils," T. W. Chalmers, and a new edition of "Industrial Electrical Measuring Instruments," K. Edgecumbe (*Constable and Co., Ltd.*); "Modern Engineering Measuring Tools," E. Pull, "Military Observation Balloons," E. J. Widner, and "Seasoning of Wood: A Treatise on the Natural and Artificial Processes employed in the Preparation of Lumber for Manufacture," J. B. Wagner (*Crosby Lockwood and Son*); "Savage Survivals," J. Howard Moore, and a selection of the lectures and essays of the late Prof. W. K. Clifford (*Watts and Co.*).

MESSRS. MACMILLAN AND CO.'s new list of forthcoming books includes a new edition of "An Elementary Treatise on Curve Tracing," Dr. P. Frost, revised by Dr. R. J. T. Bell; "The Statesman's Year Book, 1918," edited by Sir J. Scott Keltie, assisted by Dr. M. Epstein; "The Military Map: Elements of Modern Topography" (French School of War), complete in one volume, with maps; "Examination Papers in Elementary Engineering," R. M. Milne; "Alcohol and Life: A Manual of Scientific Temperance Teaching for Schools," J. A. Hunter, illustrated; "Essentials of Practical Geography," B. C. Wallis (Practical Modern Geographies); "A Geography of America," T. Alford Smith (Practical Modern Geographies).

OUR ASTRONOMICAL COLUMN.

Minor Planets.—Mr. H. E. Wood records a number of minor planets on plates taken last year at Johannesburg. They have been identified by M. Louis Fabry (Marseilles Circular, No. 10). The most interesting is 722 Frieda; this planet had not been observed since its discovery in 1911, so its recovery is fortunate. The *Astronomical Journal*, No. 729, contains elements of an unidentified planet discovered at Washington by Mr. G. H. Peters last November. It may be identical with 293 Brasilia, 1906 WF, or 1911 LU. If new, he proposes the name Washingtonia. Prof. Barnard followed the Wolf planet DB until April 4, when its magnitude was 15. It has been so well observed that it ought to be possible to secure its re-observation at the next perihelion in 1922.

The Cepheid Variable SU Cassiopeiæ.—Further investigations of this interesting variable star have been made by W. S. Adams and H. Shapley (*Astrophysical Journal*, vol. xlvii., p. 46). Mr. Shapley had already shown that the variation could not be interpreted as the result of the rotation of a simple ellipsoidal body, and the conclusion that the star is a Cepheid has been verified by the new spectroscopic observations. The range of photographic magnitude, according to Parkhurst, is from 6·52 to 6·99, and the variations of radial velocity, -18 to $+4$ km., are correspondingly small. A period of 1·9495 days satisfies both series of changes, and the epoch of maximum negative velocity precedes the maximum of light by 0·05 day. The spectral type varies from A9 at maximum to F5 at minimum. Taking the visual magnitude as 6·23, as given by Boss, the spectroscopic parallax is identical with that derived by Van Maanen, namely, $+0{\cdot}010'' \pm 0{\cdot}003''$.

New Double Stars.—Mr. R. G. Aitken's twenty-fourth list, giving details of 100 new double stars, appears as Lick Observatory Bulletin No. 306. This observer's systematic survey of the sky was initiated in 1899, and the present list brings his total published discoveries up to 3000, the region covered being from the pole to declination 14° S., and to declination 22° S. from 13h. to 1h. right ascension. All the stars included are under 5″ in distance, and in the present list nearly half are less than 1″ apart, while sixteen do not exceed 0·3″. The brightest star included is 41 Ophiuchi, the components of which are rated as magnitudes 4·6 and 7·6, the position angle and distance being 298° and 0·52″ respectively.

Journal of the Chaldean Society.—We have pleasure in directing attention to a small astronomical magazine which is issued quarterly by the Chaldean Society under the title of *The Chaldean*. The publication has now reached No. 10 of the first volume, and while dealing with astronomy generally, its special appeal appears to be to observers of meteors. The recent issue includes an article on astronomical photography, and several notes on meteors by Mr. Denning and others. A feature of particular interest is a facsimile of a page from the observation book of the late Prof. A. S. Herschel, which furnishes a good example of the method of recording meteors. Communications should be addressed to the editor, Mr. J. Hargreaves, Bennington, Stevenage, Herts.

RECENT WORK IN MINERALOGY AND PETROLOGY.

A mineral variously labelled johannite and uranopilite in collections has yielded to Messrs. E. S. Larsen and G. V. Brown the composition $RO.UO_3.SO_3.4H_2O$, where $R = Cu, Fe, Na_2$ (the *American Mineralogist*, vol. ii., p. 78, 1917). The new species thus indicated is called gilpinite, from the typical locality Gilpin Co., Colorado; but a Cornish specimen, one of those styled uranopilite, proves to be identical. The authors insist that optical tests under the microscope are characteristic, and that their application shows that more than one-third of the hundred specimens of "secondary uranium minerals" examined from various museums are incorrectly labelled.

Mr. A. E. V. Zealley, in "Notes on Newly Recorded Rhodesian Minerals" (Proc. Rhodesia Sci. Assoc., vol. xvi., p. 17, 1917), includes an account of the stanniferous tantalite of the Victoria tinfield, discovered in 1911, but not hitherto described. Two other Rhodesian occurrences of tantalite are noticed.

Messrs. R. C. Wells and B. S. Butler describe (Journ. Washington Acad. Sci., vol. vii., p. 596, 1917) a mineral sulphide of tungsten, under the name of tungstenite. The composition is probably WS_2, and the specific gravity is near 7·4. It looks like graphite, and has a hardness of only 2·5. This mineral occurs in some abundance in a vein with galena, pyrite, tetrahedrite, and argentite, in Salt Lake Co., Utah.

The view advanced by Mr. J. B. Scrivenor in 1910–14 as to the age of the detrital tin deposits of the Kinta district, Perak (see Nature, vol. xciv., p. 348), has now been disputed in a detailed paper by Dr. W. R. Jones (Quart. Journ. Geol. Soc., vol. lxxii., p. 165, 1917). Mr. Scrivenor urged that these bouldery deposits were derived from the surface of Gondwanaland during the Permian ice-age, which is responsible for the Talchir Beds of India. Dr. Jones, however, connects the tin ore with the Mesozoic granite now *in situ* in the district, and he brings forward strong evidence to show that there is only one alluvial tin-bearing series in Kinta, instead of two, superposed on one another, and separated by a long geological interval.

Those acquainted with the work of Mr. W. H. Goodchild on the Insizwa Range in the Cape Province (Inst. of Mining and Metallurgy, Bull. 147, 1916) will welcome the publication of Dr. Du Toit's researches in the area, extending from 1903 to 1912 (Du Toit and Rogers, "The Geology of Part of the Transkei," South Africa Geological Survey, Explanation of Sheet 27, 1917). The geological map, showing a magnificent series of dolerite sills, penetrating the Karroo strata up to the highest Stormberg beds, is now also issued, on a scale of 1 : 247600. The Insizwa gabbro, with its copper ores bearing nickel and platinum, is included in the north-east of the sheet, and the memoir contains a map showing the whole of the gabbro-norite masses. The three sulphides—chalcopyrite, pentlandite, and pyrrhotine—have separated from the igneous rock in the order in which they are here named, as a gravitative differentiation-product in the concave floor of a great sill. Forty-five miles of visible contact along the base of this sill await systematic exploration. The occurrence is discussed, in comparison with that at Sudbury, in the recently issued report of the Ontario Nickel Commission.

Prof. R. A. Daly ("Low-temperature Formation of Alkaline Felspars in Limestone," Proc. Nat. Acad. Sci., vol. iii., p. 659, 1917) describes a dolomite from Waterton Lake, on the Montana and Alberta border, which contains 34·5 per cent. by weight of orthoclase and

3·1 per cent. of albite. The author compares this with recorded occurrences of albite in Jurassic and other unmetamorphosed limestones in Europe. Issel's discovery (*Comptes rendus*, February 24, 1890) of albite crystals enclosing radiolaria in a Cainozoic limestone may be added to those quoted. Prof. Daly concludes that the alkaline felspars of Waterton crystallised out, like the European examples, at the sea-floor, or soon after the burial of the associated dolomite, and at temperatures which may have been well under 100° C. Time, he points out, may be an important factor, and this has to be borne in mind in experimental work on such productions.

Mr. W. A. Tarr (*Amer. Journ. Sci.*, vol. xliv., p. 409, 1917) has examined with much care the elongated chert-lumps in the Burlington Limestone of Missouri, a formation of Lower Carboniferous age. Because he finds no remains of siliceous organisms associated with the chert, and only a partial replacement of originally calcareous fossils, he criticises the view that flint is commonly a pseudomorph of portions of the limestone in which it occurs, and remarks that, had the first investigations been made on material collected in Missouri, the theory that attributes the material of flint in other cases to the solution of organic remains would not have been propounded. This shows that the author attaches little weight to the mass of evidence collected outside Missouri; yet his reading has evidently been extensive. No reference is made to the frequent occurrence of silicified oolitic rocks, from the Assynt Limestone upwards, in which all the structure of the original limestone is retained, nor to the remarkable suggestion made by R. Liesegang as to the rhythmic deposition of flint layers by water holding silica in solution. Mr. Tarr does well to emphasise the fact that flint formation goes on at an early stage in the consolidation of limestone, since pebbles of the flint are often found in the next following deposits; but it does not follow from this that flint nodules represent gelatinous matter precipitated directly on the sea-floor. The shrinkage-cracks in the Missouri flint, filled by limestone, and Mr. Tarr's interesting experiments on the precipitation of silica, help towards his conclusion that the flint in the Burlington Limestone is not a replacement of the calcareous rock; but this by no means disposes of the cases where flint masses spread out into successive layers of a limestone, or of the thousands of sections from Cretaceous or Carboniferous material that are stored in European collections. We read this paper with the feeling that, if Mr. Tarr has proved his case for the Missouri example, he has dealt with an exceptional occurrence which certainly deserved description.

It is characteristic of the association of the sciences in technical industries that geologists should be asked to look for "pulpstones." Mr. L. H. Cole has, in consequence, tested certain Canadian sandstones "to determine their suitability as pulpstones" (Canada, Dept. of Mines, Mines Branch, Bull. 19, 1917). These are used in wood-pulp mills, and should tear the fibres apart rather than cut them. In the case of sandstones, the grains should be of medium size and medium angularity, and the stone must resist considerable stresses. Diagrams of the grinding machines add interest to this useful bulletin.

Mr. H. Ries describes a gritty plastic "clay" resembling löss (*Amer. Journ. Sci.*, vol. xliv., p. 316, 1917), which proves to consist of 98·5 per cent. of small crystals of dolomite and 1·5 per cent. of iron oxide and alumina. He suggests that the flat faces of the dolomite rhombs, coming into contact or separated only by a film of water, may account for the plasticity, surface tension holding the grains together, but allowing of slipping along their faces.

The phosphate deposits of Saldanha Bay, north-west of Cape Town, have been reported on by Dr. A. L. Du Toit (S. Africa Geol. Survey, Mem. 10, 1917). The material contains from 10 to 22 per cent. of phosphoric oxide; but this is mostly combined with aluminium and iron, having been produced by the action of ancient guanos on underlying granitic rocks. The author discusses the value of such phosphates as fertilisers, making no attempt in his summary to reconcile the somewhat contradictory statements of agricultural chemists, but pointing out the need for experiments on natural lines under biochemical conditions. His proper mistrust of Germany should not have led him into the error of asserting that the citric acid test of availability of phosphorus was "devised in Germany for the purpose of enabling that country to supply the markets of the world with highly citric-soluble basic slag."

Mr. T. A. Jaggar, jun. (Journ. Washington Acad. Sci., vol. vii., p. 277, 1917), describes the phenomena presented by the *aa* and *pahoehoe* types of Hawaiian lava during the cooling of the mass. He suggests that the quantity of confined gas for each unit of volume of melt may be a controlling factor. The expansion of gas in the *aa* type may be more rapid, but "with so many variables there is no cause for wonder that the distinction is as yet unexplained." The author proposes the term "dermolith" for the *pahoehoe* type, which has a crust or skin as its chief character, and the term "aphrolith" (foam-stone) for types of lava which divide on the surface, like *aa*, into lumpy vesicular units. He prefers "lith" to "lite" as a termination, on the well-established analogy of "monolith."

Prof. R. A. Daly has furnished a useful synopsis of our knowledge of the nature of rocks in the Pacific islands (Bull. Geol. Soc. America, vol. xxvii., p. 325) and urges that much more observation is required. He believes that, so far as can be judged at present, the primary magma under the Pacific is of basaltic composition, giving rise to andesites and picrites by differentiation, and to alkaline rocks by solution of comparatively small proportions of limestone.

G. A. J. C.

THE BIRD CULT OF EASTER ISLAND.

In the issue of *Folk-lore* for December last Mrs. Scoresby Routledge gives a singularly interesting account of the bird cult of Easter Island. The sacred bird is the sooty tern (*Sterna fuliginosa*), and the valued privilege of securing the first egg is a matter of competition between members of the Mata-toa group, the right to become a competitor being acquired only by supernatural agency. The selection is made through a dream vouchsafed to a divinely gifted individual, the Iviatua. The candidate on selection takes a new name, and the bird-name thus conferred was given to the year in which victory was achieved, thus forming an easily remembered system of chronology. It is also significant that this bird cult is connected with the statues for which the island is famous. The bird-man used to spend his official year on the mountain in which the monoliths were quarried; the bird initiation of children was also performed in connection with the statues, and the ring design on the back of the images was reproduced at the ceremony on the children's backs. There seems reason to believe, says the writer, that the people who originally celebrated the bird cult included in it reverence for the statues. The ancestors of the present inhabitants were, therefore, either the makers of the monoliths of Easter Island, or, if the bird worshippers represent a more recent migration, the old religion of the images was blended into, and perpetuated by, the more recent culture.

The conclusions of Mrs. Scoresby Routledge have been extended by a second paper in the same issue of *Folk-lore* by Mr. Henry Balfour on the ethnological affinities of the natives of Easter Island. He arrives at the conclusion that the island culture is composite, and exhibits traces of fusion of at least two stocks. The first was a Melanesian migration, which introduced the practice of distending the ear-lobe, a characteristic style in art, certain special types of stone implements, and the cult of the frigate-bird, which was designed as a magical method of increasing the food supply. This Melanesian culture was submerged by a wave of Polynesian immigrants, to whom is due a new bird cult, aiming at increasing in a like magical way the supply of birds and eggs. This culture seems to be closely allied to that of the Solomon Islands, and "it seems likely that the symbolism of many of the ideographic signs employed in the Easter Island script may be explained by a study on the spot of closely similar designs still used in the Solomon Islands, the symbolic significance of which might be ascertained before it is too late." Thus a survey of the materials collected by Mr. and Mrs. Scoresby Routledge, interpreted by the wide ethnographical knowledge of Mr. Henry Balfour, seems to bring us at last within reach of a solution of the mystery of Easter Island. It may be hoped that the clues suggested by him will be followed by some careful local anthropologist.

SCIENTIFIC ACTIVITIES OF THE SMITHSONIAN INSTITUTION.

THE report of the secretary of the Smithsonian Institution for the year ending June 30, 1917, has been received from Washington. It reviews the affairs of the institution, summarises briefly the operations of its several branches, and, in addition, contains, in the form of appendices, detailed reports by the assistant-secretary and others directly in charge of its various activities.

The permanent fund of the institution now amounts to 200,000*l.*, the limit authorised by Congress. The income during the year under review reached 17,730*l.*, and with the cash balance from the previous year the total resources for the financial year amounted to 26,672*l.* The disbursements for the same period were 24,830*l.*

The former secretary of the institution, the late Prof. S. P. Langley, demonstrated in 1896 the feasibility of mechanical flight by a machine heavier than the air propelled by its own power. As an indication of America's debt to his researches, his name is fittingly preserved in the name "Langley Field," a tract of some 1800 acres near Hampton, Va., where important experiments in aviation are now being carried on. The large machine with which Prof. Langley experimented in 1903 proved its worth and its capability of flight during the year reviewed by the report. The institution has established a research laboratory at Langley Field for scientific investigations, and among several sub-committees engaged in the study of aeronautic problems may be mentioned those on aerial mail service, aero torpedoes, aircraft communicating, airplane mapping, the relation of the atmosphere to aeronautics, and the construction and navigation of aircraft.

The usual activities of the institution were continued during the year in carrying out one of its fundamental objects, the increase of knowledge. Various explorations and researches were inaugurated or participated in by the institution, covering the different divisions of astronomical, anthropological, biological, and geological science; but the secretary points out that opportunities for undertaking important lines of investigation are constantly being lost through lack of means to carry them into execution. Moreover, several proposed expeditions to various parts of the world have been delayed temporarily by the war.

The report directs attention again to the work of the Research Corporation, organised in 1912, and having as its officers men particularly interested in the development of industry. The principal income of the corporation is derived from royalties for the use of the Cottrell process for the electrical precipitation of suspended particles. Dr. F. G. Cottrell, the inventor of the process, offered his patents to the Smithsonian Institution, but as it was impracticable for the institution to administer them commercially, the Research Corporation was organised for that purpose. The corporation seeks to do for industry what other institutions are doing for science, for medicine, and for the improvement of social conditions. An annual fellowship has been established "open to general competition for the purpose of encouraging and assisting men of science in the prosecution of their investigations." To the successful competitor the corporation offers an honorarium of 500*l.* and the assistance of the corporation in securing the most favourable opportunity for prosecuting the particular object of study.

The additions to the libraries of the institution and its branches during the year numbered more than 9000 volumes and pamphlets. Among important gifts were a first consignment of 561 volumes and 293 pamphlets, part of the botanical library of Dr. J. D. Smith, of Baltimore, and the scientific library of Dr. E. A. Mearns, an American zoologist who died in 1916.

With the secretary's report for 1917 may be noticed conveniently the annual report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1916, which has now come to hand. This handsome and well-illustrated volume of 608 pages includes the secretary's report for 1916, to which we directed attention last year; but its most attractive feature is the comprehensive general appendix, with its invaluable selection of miscellaneous scientific memoirs intended for the use of correspondents of the institution, teachers, and other workers engaged in the promotion of knowledge. Among the memoirs are original contributions, translations from foreign periodicals, and reprints from scientific serial publications printed in English.

The original contributions include papers by Prof. C. G. Abbot, director of the Astrophysical Observatory of the institution, on news from the stars; Prof. Paul Bartsch, curator of marine invertebrates in the U.S. National Museum, on pirates of the deep—stories of the squid and octopus; Prof. Albert Mann, on the economic importance of the diatoms; Mr. W. E. Safford, economic botanist to the U.S. Department of Agriculture, on narcotic plants and stimulants of the ancient Americans; Dr. J. W. Fewkes, on a prehistoric Mesa Verde Pueblo and its people; and Mr. Van H. Manning, on mine safety devices developed by the United States Bureau of Mines.

The translations include an address by Prof. A. Pictet, professor of chemistry at the University of Geneva, on molecular structure and life, published in the *Revue Scientifique* and the author's "Extrait des Archives des Sciences physiques et naturelles, Geneva, 1915"; a lecture delivered in German in 1914 in Vienna by Prof. F. Berwerth, on the origin of meteorites; and a lecture given in French by Prof. M. Caullery, exchange professor at Harvard University in 1916, on the present state of the problem of evolution.

PHYSICAL WELFARE AND PUBLIC LIBRARIES.

THE fourth annual report, that for the year ending December 31 last, was submitted to the trustees of the Carnegie United Kingdom Trust by the Executive Committee on February 26, and some of the matters dealt with in it are here summarised. The administration of the trust during the year was not an easy task. Restrictions of various kinds arising out of the war have militated against smooth and rapid progress, but the record of work done is, both in quality and amount, satisfactory.

The new developments opened up by the Executive Committee, with the approval of the trustees, are described in the report. The normal income of the trust in 1917 amounted to 124,419*l.*, and the grant promises made by the trustees in connection with these new developments reached for the year the total of 122,174*l.* For the last three years, during which the trust may be said to have been in full operation, the average amount of grant promises per annum has been 127,517*l.*, and the average normal income for the three years in question 11,528*l.* less than that sum. The income for the year 1917 may, however, be regarded as the minimum income available in the future, but even that figure is slightly less than the average grant commitment for the last three years.

Infant Welfare Centres.

The physical welfare of mothers and children, with all that is implied in that comprehensive phrase, has occupied public attention largely in recent months, and the committee's labours have also been directed towards furnishing, within the limits of its powers, some assistance in the solution of this national problem. The elaborate surveys referred to in the last annual report have been completed and published.

The committee has determined to erect and equip buildings for six infant welfare centres in urban areas in the United Kingdom. Broadly speaking, the centres will comprise an infant clinic, pre-natal clinic, school for mothers, and nursery, and the necessary accommodation for the staff. These buildings will be maintained by the local authority concerned by means of local rates and Imperial grants, and will be given on the following conditions:—That a suitable site is provided, and that the plans and estimates for the building prove acceptable to the trustees; that the authority undertakes the efficient maintenance of the centre as a part of its comprehensive system of physical welfare approved by the Local Government Board for the purpose of Imperial grants; and that full reports of the work of the centre are submitted to the trustees annually.

In selecting the urban areas to which the offer described above has been made, the committee has been influenced in the main by the likelihood of the local authority affording to the experimental institution the best chance of permanent success. The following towns have received and accepted the trustees' offer of assistance:—Birmingham, Liverpool, Rhondda, Shoreditch, Motherwell, and Dublin.

Central Institutes.

Representation has been made to the committee that it might be extremely useful to Government Departments, local authorities, and voluntary organisations if a central institution were created the activities of which might serve to assist the movement generally. Under suitable conditions and with fully representative management such an institute might be of great value not only to voluntary workers, but also to authorities throughout the country. Its main functions would include the following:—(*a*) To form independent opinions in regard to the desirability or need of certain courses of action or policy, which could, when necessary, be presented to Government Departments or local bodies with the weight of recognised authority behind them; (*b*) to encourage, and to some extent direct and coordinate, experimental work by voluntary agencies which, if shown to be successful, could be recommended for official consideration; (*c*) to organise a thoroughly efficient information bureau by means of which inquirers could obtain full, accurate, and up-to-date knowledge of arrangements made both in this country and abroad for maternal and infant welfare, in addition to assistance and advice in regard to any investigation or personal work they desired to undertake; (*d*) to provide an adequate library of reference of English and foreign literature bearing on the subject; (*e*) to organise conferences, meetings, lectures, etc., for the instruction of those interested in infant welfare and for the education of public opinion in matters relating thereto; (*f*) to consider the training desirable for workers in maternity and infant welfare centres, health visitors, etc., and to formulate conditions of training which might be accepted as the standard for the country as a whole.

Accordingly, the committee has decided to provide the necessary accommodation and equipment for two institutes of this character—one to be situated in London and one in Edinburgh. The trustees will be responsible only for the capital outlays involved, and will not be concerned with the provision of the income required to maintain the institutes, although they will need to be satisfied that proper financial support is forthcoming. It is not contemplated that the function of the institutes will, in any way, supersede or encroach upon the proper spheres of the various voluntary and statutory bodies, and funds for their efficient administration ought not to be difficult to find, having regard to their wide sphere of usefulness. Preliminary consideration has already been given to the organisation of the two institutes referred to, and there seems every prospect that the suggestions will prove acceptable.

Travelling Welfare Exhibition.

In connection with the valuable report for Scotland received from Dr. Leslie Mackenzie, the committee's attention was directed to the useful work undertaken by the Travelling Welfare Exhibition inaugurated by the National Union of Women Workers of Great Britain and Ireland. The work consists essentially in preparing the ground and educating public opinion as to the necessity for higher standards of domestic hygiene as applied to mothers and children. In order to extend the opportunities afforded by the exhibition, the committee has agreed to render financial assistance to the National Union of Women Workers in order that a second travelling exhibition may be set on foot in Scotland and two similar exhibitions established in England and Wales. The need for propagandist work of this nature ought to be only temporary, but it is important that it should be undertaken immediately in order that public opinion, particularly in the less advanced communities, may be prepared to welcome the larger ideals of national service to which Imperial and local effort will presently be directed.

Play Centres.

Another aspect of the problem which has engaged the attention of the committee is the question of the fuller provision of play facilities for children. The Government Education Departments have realised the possibilities for good which might arise from the efficient administration of centres, where children may have recreation after school hours, and grants are now available for the assistance of municipal effort in this direction. In certain cases, however, the initial equipment of ground suitable for the purpose, which has already been acquired by local authorities, might prove an obstacle in the way of the early establishment of play centres. The committee, therefore, proposes to consider favourably applications for grants from local authorities for the preparation and equipment of such open spaces for children's playgrounds, on condition that the authorities are prepared to maintain them.

Library Policy.

The committee expressed the view last year that consideration of library matters should not be deferred entirely on account of the war, and that steps should be taken to strengthen a movement which will occupy a place of increased importance after the cessation of hostilities, when various reconstructive measures—educational and social—will call for prompt attention. Endorsement of this view has been given by the increased interest taken in libraries, and their future position in the educational system of the country, by those who are engaged in the consideration of reconstruction after the war. Probably the library movement has never before received the same degree of public attention as during the past twelve months.

There is a universal consensus of opinion in the library world that the greatest barrier to progress with which the public library movement is confronted is the present limitation of rate aid; in this view the committee fully concurs. It is useless to expect the library movement to fulfil its enlarged function in the educational system of the future, unless adequate means are forthcoming for its efficient development and maintenance. From time to time suggestions have been placed before the trust to the effect that it might supplement by endowment the meagre incomes at present available, and so make up for the deficiencies which exist in numerous instances owing to the inadequacy of the rate produce. Any step of this character would, in the opinion of the committee, be disastrous, and inevitably postpone the day when larger rating powers are placed within the reach of local authorities.

The Library Association has instituted an inquiry into the existing provision of scientific and technical literature in public and other libraries in the United Kingdom. Probably there is no branch of public library work relatively so neglected at the present time as that which deals with technical literature. The reason is not far to seek. Technical books bearing on industrial operations, scientific and commercial, are costly, and rapidly become out-of-date. The meagre income available for the purchase of books does not, as a rule, allow of extensive outlay in this direction. Book selection committees are apt to look askance at proposals which involve a substantial expenditure for the acquisition of a single work. But in the future, when the public libraries become more closely correlated with the educational system of the country, their reference sections will come to be of increasing importance. The existing state of affairs needs further examination, and the trust has responded to an appeal from the Library Association in order that a complete review may be obtained.

The activities of the Central Library for Students have continued to widen, and its work has promise of considerable importance in the future. The function of the library is to supply students with the loan of necessary books which they are not in a position to obtain otherwise. The books are lent, as a rule, to classes organised under the Workers' Educational Association, the Adult School Movement, or other similar organisations of working men and women engaged in systematic courses of study; they are also lent to individual students. At the present time there is necessarily a considerable number of students who are prevented from following their studies in the usual manner by reason of their absence from the United Kingdom. In neutral countries and in enemy countries hundreds of students are interned, and consequently cut off from access to text-books. The British Prisoners of War Book Scheme is a voluntary organisation expressly constituted to supply books and literature to British subjects so situated. In normal times these students would have enjoyed the facilities provided by the Central Library for Students, and the committee has accordingly made a special grant to the Central Library in order that the organisation named above may supply more adequately books of study to those who are at present aoroad. It is hoped that on the cessation of hostilities these books will be returned to this country, and, in that event, it has been arranged that they shall be handed over to the Central Library as a permanent addition to its contents.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Mr. Thomas J. Mackie has been appointed professor of bacteriology in the South African Medical College, Cape Town.

The impending resignation of the chair of materia medica and clinical medicine in the University of Edinburgh by Sir Thomas R. Fraser, F.R.S., is announced.

Mr. F. J. Harlow has been appointed to succeed Dr. R. S. Willows as head of the mathematics and physics department of the Sir John Cass Technical Institute.

Dr. T. Franklin Sibly has been appointed professor of geology at Armstrong College, Newcastle-upon-Tyne, in succession to the late Prof. Lebour. Dr. Sibly has been since 1913 professor of geology at University College, Cardiff, and was lecturer in geology at King's College, London, during the preceding five years. He was an 1851 Exhibition Research Scholar in 1905–7, and is a doctor of science of both London and Bristol Universities.

The course of public lectures on "Some Biological Problems of To-day" will be continued in the second term at University College, London, on Mondays, at 5 p.m. instead of at 4 p.m., as in the first term. Major Martin Flack, member of the research staff of the National Medical Research Committee, will lecture on "The Physiological Aspects of Flying" on May 6; and Dr. H. M. Vernon, of the University of Oxford, will lecture on "Industrial Efficiency and Fatigue" on May 13. Further particulars of the course may be obtained by sending a stamped addressed envelope to the Secretary, University College, London (Gower Street, W.C.1).

A series of pamphlets urging the national necessity for the passage of the Education Bill, providing compulsory whole-time education until the age of fourteen and compulsory part-time education for some years afterwards, has been issued and distributed by the Messrs. Tootal Broadhurst, Lee Co., Ltd., of Manchester and London. A set of four leaflets is entitled "The Great Decision," and the various parts are called "Now or Never," "Our Success or Failure," "A Just Complaint," and "A First Step." Throughout they urge the paramount importance of improved educational facilities, if the future well-being of the nation is to be assured. Over and above the proposals of the Education Bill, one leaflet urges that "a straight road to the university should be open to all who desire the fullest development of their intellect. Only by such provision for complete knowledge of the arts and sciences can we as a nation maintain our place in the world." Each of the pamphlets appeals to the reader in the following words:—"For your own sake, your children's sake, your country's sake, do all *you* can to push through the Education Bill. Get in touch with your M.P."

THE following letter from Lord Stamfordham, the King's private secretary, has been received by Mr. Fisher, President of the Board of Education:—"It has given the King and Queen much pleasure to visit recently schools of various types, and thus gain an insight into the daily life of the rising generation at work and at play. Their Majesties are aware of the magnificent response which the educational service throughout the country has made to the demands of the present time, not only in its contribution to the fighting forces, but also in the assistance which it has rendered in many kinds of important war work. Above all, they wish to express their admiration of the self-denial and devotion of the teachers, who, it is evident, while training the mind and body of their pupils, recognise the importance of the formation of character. These visits have brought home to the King and Queen the keenness and patriotism of the youth of the country. They realise the unselfish and hearty manner in which boys and girls, inspired by the example of their teachers, have formed War Savings Associations, subscribed money for charitable purposes, and, by their handiwork, contributed to the personal needs and comforts of the troops. Their Majesties feel that the nation can be proud of its young sons and daughters, whose example during this great war augurs well for the future of our race. I am commanded to request you to convey to the school authorities and teachers the hearty congratulations of the King and Queen upon the admirable manner in which the public service of education is being maintained, the progress of which their Majesties will ever watch with interest and sympathy."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, April 17.—Sir Napier Shaw, president, in the chair.—E. G. **Bilham**: The variations of underground watel-level near a tidal river. The paper is chiefly devoted to a comparison of records from the Kew Observatory water-level recorder and the Richmond Lock tide-gauge for a period of two years beginning May, 1914. The seasonal variations, determined from lunar-monthly means, were found to be very similar, as was to be anticipated on general grounds. A better method of determining the extent to which the variations of subsoil water-level were directly controlled by the River Thames consisted in the analysis of the well records to find tidal oscillations analogous to those which were well-marked in the river. The well responds but slightly to the lunar semi-diurnal tide, but the lunar-fortnightly oscillation is well reproduced with a lag of five days and a reduction of amplitude in the ratio of 1 to 14 (approximately). After allowing for the direct action of the river, the well is found to be very sensitive to local rainfall during winter months. The effects of rainfall upon river-level and underground water-level appear to be in many respects closely similar.—J. **Fairgrieve**: Suggestions as to the conditions precedent to the occurrence of summer thunderstorms, with special reference to that of June 14, 1914. The paper deals particularly with the thunderstorm of June 14, 1914. The meteorological phenomena accompanying the rainfall are put on record. The cloud distribution, the barometric pressure, the wind movements, and the temperature are specially dealt with. From an examination of the data it is evident that the clouds and the rainfields lie in parallel belts, and that the former appear some hours before the rain begins to fall. It is suggested that this belting of wind and rain may be due to rippling on a large scale, the rippling being brought about by the interaction of two currents of different temperatures. If the conditions are unstable, and especially if relief also induces disturbance, thunderstorms will develop along lines of rippling, and will drift with the wind. Thunderstorms have apparently three movements, a development along a belt, a sideways movement in the direction of the prevailing wind, *i.e.* to leeward, and a spread to windward. The first may be due to rippling; the second is a drift; the third may be explained if it is granted that a local ridge of high pressure develops along the axis of the thunderstorm. The thunderstorm then breaks up into two belts, of which the leeward soon dies out owing to the lack of a supply of rising air.

PARIS.

Academy of Sciences, April 8.—M. Paul Painlevé in the chair.—Col. **Vallier**: Obituary notice of Gen. Zaboudski. Gen. Zaboudski, correspondant in the section of mechanics, was assassinated in Petrograd in March, 1917, but his death has only recently come to the knowledge of the Academy.—A. **Lacroix**: Some sodium rocks, lode-like in character, of the Archipelago of Los, French Guinea. Thirteen minerals are described and complete analyses given. Even in the rocks most removed from syenites the alkaline character persists, with a predominance of soda over potash. The connection between the lodes and the surrounding syenites is also indicated.—E. **Fournier**: The causes and effects of the resistance of water to the translation of ships' hulls.—L. **Maquenne** and E. **Demoussy**: The influence of acids on germination. Care has to be taken to prevent the disturbing influence of calcium salts on the experiments, calcium derived either from the water or from the integuments of the seeds themselves. It is concluded that the mineral acids, even in extreme dilution, are poisonous and hinder germination.—E. **Ariès**: The anomalies presented by the saturated vapour pressures of certain diatomic liquids. A comparison of the formula derived by the author in previous communications with the experimental figures for oxygen and nitrogen shows marked differences; the data for nitric oxide are also not in agreement with the calculated figures. The causes of the divergence are discussed.—B. de **Fontviolant**: Strains developed in bridges with straight girders, with double lines, when one line only is loaded.—D. **Eydoux**: Conduits closed at both ends. Accumulators and buffer cylinders.—E. **Baticle**: The determination of the most advantageous dimensions of the principal elements of a hydraulic installation.—A. **Mailhe** and F. de **Godon**: A new preparation of the methyltoluidines by catalysis. The method described in a preceding communication of preparing monomethylaniline and dimethylaniline by passing a mixture of the vapours of methyl alcohol and aniline over alumina heated to 350° to 400° C. is now shown to be applicable to the preparation of the methyltoluidines.—E. **Belot** and C. **Gorceix**: The experimental reproduction of the formation of great mountain chains.—E. **Hesse**: *Caulleryella anophelis*, a schizogregarine parasite of *Anopheles bifurcatus*.—R. **Combes**: The equine paratyphoid bacillus.—A. **Vernes**: The precipitation of an organic colloid by human serum, normal or syphilitic. It is shown to be possible so to regulate the state of a colloidal suspension that it can be flocculated by syphilitic serum, and not flocculated by normal serum.—R. **Dubois**: The synthesis of luciferine. Luciferine can be synthesised by the action of coluciferase upon taurine.

April 15.—M. L. Guignard in the chair.—G. **Humbert**: The representations of an integer by certain indefinite quadratic forms.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: The density of the blood after great hæmorrhage. With loss of blood there is a progressive lowering of the density, and the determination of the density of the blood gives a better measure of the loss through a wound than any other method available.—G. A. **Boulenger**: Considerations on the affinities and geographical dispersion of the Lacertidæ.—G. **Julia**: Rational substitutions.—R. **Garnier**: The irregular singularities of linear equations.—M. **Valiron**: The maximum of the modulus of entire functions.—M. de **Pulligny**: Some new remarks on the approximate quadrature of the circle.—E. **Hernandez-Pacheco**: The Cambrian of the Sierra de Cordoba, Spain.—L. **Gentil**, M. **Lugeon**, and L. **Joleaud**: The age of the pre-Riffian layers and the crushing of the South Riffian Strait, Morocco.—H. **Perrotin**: The nocturnal cooling of the lower layers of the atmosphere.—J. **Legendre**: The biology of the Madagascan perch.—M. **Heitz-Boyer**: An attempt at the mechanical reduction of fractures.

BOOKS RECEIVED.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. iii., Gypsum and Anhydrite, by Dr. R. L. Sherlock and B. Smith; and Celestine and Strontianite, by Dr. R. L. Sherlock. Second edition. Pp. iv+64. (London: H.M.S.O.) 2*s.* net.

Story Lives of Great Scientists. By F. W. Rowbotham. Pp. 266. (London: Wells Gardner and Co., Ltd.) 3*s.* 6*d.*

A Flora of Epsom and its Neighbourhood. By the Rev. T. N. Hart Smith-Pearse. Pp. 107. (Epsom: L. W. Andrews and Son.) 3*s.* 6*d.* net.

The Manufacture of Intermediate Products for Dyes. By Dr. J. C. Cain. Pp. xi+263. (London: Macmillan and Co., Ltd.) 10*s.* net.

A Check List of North American Amphibians and Reptiles. By L. Skejneger and T. Barbour. Pp. 125. (Cambridge, Mass.: Harvard University Press.) 10*s.* 6*d.* net.

British Museum (Natural History). Report on Cetacea Stranded on the British Coasts during 1917. By Dr. S. F. Harmer. Pp. 5 to 21. (London: British Museum (Natural History).) 2*s.* 6*d.*

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. iv., No. 2, Cephalodiscus. By Dr. W. G. Ridewood. Pp. 11–82. (London: British Museum (Natural History).) 12*s.*

DIARY OF SOCIETIES.

THURSDAY, May 2.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—Nerve-End Cells in the Dental Pulp: Dr. J. H. Mummery.—The Nature of Growths in Colloidal Silica Solutions: H. Onslow.

ROYAL SOCIETY OF ARTS, at 4.30.—The Freedom of the Seas: Gerard Fiennes.

LINNEAN SOCIETY, at 5.—A New Fresh-water Shrimp (*Caridina*) from Fiji: G. M. Thomson.—(1) *Bennettites scottii*, sp. nov., a European Petrifaction with Foliage; (2) A Survey of the Biological Aspect of the Constitution of Coal: Dr. Marie Stopes.

FRIDAY, May 3.

ROYAL INSTITUTION, at 5.30.—The Spinning Top in Harness: Sir G. Greenhill.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—*Discussion*: Employment of Women in Munition Factories. Opener, Miss O. E. Monkhouse.

SATURDAY, May 4.

ROYAL INSTITUTION, at 3.—Modern Investigation of the Sun's Surface: Prof. H. F. Newall.

MONDAY, May 6.

ARISTOTELIAN SOCIETY, at 8.—Practical Dualism: Miss E. E. Constance Jones.

SOCIETY OF ENGINEERS, at 5.30.—Modern Shipbuilding and Economy in Material: J. W. Isherwood.

SOCIETY OF CHEMICAL INDUSTRY, at 7.30.—The Interaction of Aluminium and (*a*) the Alcohols, (*b*) the Higher Fatty Acids, (*c*) Phenol, Cresol, and Naphthol: Dr. R. Seligman and P. Williams.—The Principles and Applications of Hot-Wire Anemometry: J. S. G. Thomas.

TUESDAY, May 7.

ROYAL INSTITUTION, at 3.—Craniologists: Prof. A. Keith.

ZOOLOGICAL SOCIETY, at 5.30.—The Arenaceous Foraminifera of the Genus Thurammina: E. Heron-Allen.—Comparison between the Lower Jaws of the Cynodont Reptiles Gomphognathus and Cynognathus: Dr. Branislav Petronievics.—A New Genus of Extinct Muscardine Rodent from the Balearic Islands: Miss Dorothea M. A. Bate.

FARADAY SOCIETY, at 5.30.—*Discussion*: The Co-ordination of Scientific Publication. Opener, Sir Robert Hadfield, Bart.

RÖNTGEN SOCIETY, at 7.45.

WEDNESDAY, May 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The Rubber Planting Industry: Prof. John B. Farmer.

BRITISH ASSOCIATION GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—*Discussion*: The Movements of the Earth's Pole. Opener, Sir F. W. Dyson.

THURSDAY, May 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Contribution to the Theory of Attraction when the Force varies as any Power of the Distance: Major P. A. MacMahon and H. B. C. Darling.—Electromagnetic Integrals: Sir George Greenhill.—Intensity Relations in the Spectrum of Helium: Dr. T. R. Merton and Prof. J. W. Nicholson.—The Outline of a Theory of Magnetic Storms: Dr. S. Chapman.

ROYAL INSTITUTION, at 3.—The Folk Lore of Bells: Sir J. G. Frazer.

ROYAL SOCIETY OF ARTS, at 4.30.—The Freedom of the Sea: Sir F. T. Piggott.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—*Discussion*: A British Electrical Proving House. Opener, C. Turnbull.

OPTICAL SOCIETY (Imperial College of Science and Technology), at 7.—Note on Spherical Aberration: T. Y. Baker and Major L. N. G. Filon.

FRIDAY, May 10.

ROYAL INSTITUTION, at 5.30.—Human Nutrition: Prof. F. Gowland Hopkins.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 5.—The Times of Sudden Commencement of Magnetic Storms: S. Chapman.—The Entropy of a Metal: H. S. Allen.—Tracing Rays through an Optical System: T. Smith.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN AND CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.

THURSDAY, MAY 9, 1918.

SOCIAL HEREDITY.

The Science of Power. By Benjamin Kidd. Pp. 306. (London: Methuen and Co., Ltd., 1918.) Price 6*s.* net.

THIS posthumous book is a vigorous, sometimes impassioned, statement of convictions, rather than a reasoned argument. In fact, the author did not believe much in reason; he did not find that it led to a knowledge of Truth. The general thesis is that we are at the beginning of a world-revolution; we have reached the limit of a disastrous pagan retrogression; Western knowledge has proved a cultural failure; we have to begin afresh. This time our ideal must be social integration, not individual efficiency as fighting animals; the integrating principle must be found, not in reason, but in collective emotion—"the emotion of the ideal"; we must cease concentrating attention on our "inborn heredity"; we must realise the limitless importance of "social heredity"; we must turn from man to woman as the psychic centre of power in the new social integration; we must seek first, not the kingdom of man, but the kingdom of heaven. There is good counsel here, we think; but the book offends even the sympathetic reader by its extremism.

Mr. Benjamin Kidd, in this sequel to his famous "Social Evolution," endeavoured to formulate human history, and this is a laudable scientific ambition. The difficulty, at this level of complexity, is to find verifiable formulæ and to avoid a false simplicity. There is some point in calling "the male of Western civilisation" the supreme fighting animal, but it is far from being an adequate scientific description. There is some warrant for saying that money-makers and militarists alike found in a vulgarised version of Darwinism (the crudity of which was left by the author unexposed) a theoretical justification of their aims and methods, but that Darwinism has had the blighting and retrograde influence for which Mr. Kidd reproached it seems very problematical.

There is a modicum of sense in the summary, more than once quoted in the book, which Bagehot gave of Darwinism, beginning: "If A was able to kill B before B killed A, then A survived"; but, on the whole, Bagehot's summary was a caricature of Darwin's Darwinism. Again, the impression conveyed by Mr. Kidd's book is that Darwin thought only of the efficiency of the struggling individual organism; in point of fact, Darwin laid emphasis on the importance of endeavours to secure the welfare of offspring and on the survival value of social instincts. It is, as the book insists, a materialism to force biological formulæ on human society, but we are not told that the fallacy of this materialism has been repeatedly exposed by sociologists of eminence, such as Tarde.

"The Science of Power" abounds in fallacious alternatives. There is really no antithesis between what Galton called "natural inheritance" (the author's "inborn heredity," not a felicitous phrase) and the extra-organismal social heritage (the author's "collective heredity" or "social heredity"). Both are big facts. We have not to choose between attaching importance to hereditary "nature" and attaching importance to the influence of "nurture" in the widest sense. The book says that an interruption of the social heritage would leave man without a trace of its age-long operation, but this ignores the fact that there has been all through a selection of the types relatively more susceptible to the integrative influence of the external registration. The social heritage, cumulatively enriched, operates as an evolving sieve, and thus indirectly, yet permanently, affects the racial type. We have not to choose between reason and emotion; we wish more of both. Choose, we are told, between individual self-expression and socialised self-subordination. Choose, we are told, between the psychic and spiritual forces that make for social integration and the biological factors that make for healthy men and women. But we decline to choose between complementary ideals. Eutopias are biological as well as psychological, personal as well as social, and if they are not regional too, they are apt to be Utopian.

The fact is that the lamented author was ever, in his zeal, prone to draw his bow too tightly. Thus, on the strength of his exceedingly interesting experiments with young hares brought up along with rabbits, young wood-pigeons fed along with hawks, and so on, he maintained the relative unimportance of inborn racial characters and an astounding doctrine of equality.

By force of constitution, function, and tradition, it has come about that woman thinks more of the race and more of the future than man does; she has long-range emotions and a far horizon, man has short-range emotions and a pre-occupation with the immediate; woman is permanently endowed with a capacity for self-sacrifice and renunciation which is foreign to the Western male; in fact, "the mind of woman has in reality already outstripped the mind of the male of the race by an entire era of evolution."

We find these "hard sayings." We cannot believe that all the good qualities of women are sex-linked, continued only in the daughters of the house. Much more probable is the view that the fundamentals of a fine character are heritable, to either sex or from either sex, like a sound physical constitution or beautiful features, yet find different expression according as they develop in man or woman. The Germans and Japanese have shown how great changes in a people may come about in less than half a century. Mr. Kidd's counsel is that "the emotion of the ideal"—which is to society like blood to the body—should be "imposed" persistently and systematically on children by wise women. This will bring about a new social integration, a new order of civilisation. "Give us the young, and we will create a new mind and a new earth in a single generation."

Mr. Kidd died in 1916, and we do not know to what extent he was able to revise what is now published in this book. We must say that we find in it what seem to us examples of exaggeration, false antithesis, and simplicist formulation; nevertheless, it is a rousing book of unmistakable sincerity and earnestness of conviction.

FORESTRY IN CORSICA, ALGERIA, AND TUNISIA.

French Forests and Forestry: Tunisia, Algeria, Corsica. With a Translation of the Algerian Code of 1903. By T. S. Woolsey, jun. Pp. xv+238. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 11*s*. 6*d*. net.

THIS book is provided with a somewhat misleading title, so that the reader expects a description of forests and forestry practice in France; whereas the three dependencies of Corsica, Algeria, and Tunisia are dealt with. The author, who was formerly a forest officer in the United States, visited these three countries and studied them as an expert. His detailed description of the distribution, management, administration, and protection of the forests may be regarded as authoritative. His remarks on sylvicultural methods are of great interest, especially to foresters in the United States and in our own Colonies, where the climatic conditions are often similar to those in the countries here described.

In Tunisia, with 1,600,000 acres of forests, the sole trees of commercial importance are the cork oak, producing cork, and the Zeen oak (*Quercus mirbeckii*), akin to our own species and yielding an excellent timber. The annual receipts of these forests vary from 24,000*l*. to 53,000*l*. The most notable technical achievements of the French foresters in Tunisia have been the protection of the oases in the Djerid and the control of the dunes at Bizerta and Cap Bon. The oasis is usually not a mere spring, but in reality a rich date-palm farm several hundred acres in area and well worth the cost of protection against drifting sand, excessive grazing, and erosion. The descriptions of the ways in which sand fences are built and of the various methods of coping with erosion are interesting. Plantations have not been successful, as the annual rainfall is only a few centimetres, and the species to be grown must, besides, withstand the burning siroccos which blow during summer. The tamarisk has succeeded, but only in a partial degree.

In Algeria there are 7,000,000 acres of forests, which mainly exist on land too poor to be cultivated by the natives. The Government controls 4,800,000 acres, which yielded in 1910 a gross revenue of 150,000*l*. Cork oak contributes the greater part of this total. Cedar, the most remarkable species, yields a small quantity of good timber annually. The Aleppo pine, which covers an immense area estimated at 1,500,000 acres, yielded no revenue until lately. Recent experiments show that it can be tapped for turpentine with some commercial success. The principal methods of regeneration are described, and as a rule sowing in carefully prepared spots is more successful than the planting out of seedlings.

Corsica, with a total area of 2,155,161 acres, has 431,000 acres of so-called forests, of which, however, only 347,000 acres are stocked with trees. The most important species is the Corsican pine, which attains a height of 150 ft. and yields a valuable timber. Its growth is vigorous up to 150 years old. It has been tapped for resin, but the tapping killed many mature trees or considerably slowed their growth. The Corsican pine is now worked on a modification of the selection system by which the trees to be felled are selected in groups. The small openings thus made in the stand give all the light necessary for the development of the seedlings. The areas felled, scattered irregularly over the forest, vary in size from one-tenth to one-fourteenth of an acre. The Corsican peasants are still a lawless set, and very difficult to control. Fire, excessive grazing by goats, trespass, and minor thefts are common; and the actions at law brought by the forest officers, whilst decreasing year by year, are still very numerous. Of 598 actions brought in 1911, no fewer than 314 ended in acquittal by complacent juries. The book concludes with an appendix, being a translation of the Algerian forest code, followed by statistics of Corsica and the clauses usual in a sale of timber in a communal forest.

THE DEVELOPMENT OF SURGERY.

The Edinburgh School of Surgery before Lister. By Alexander Miles. Pp. viii+220. (London: A. and C. Black, Ltd., 1918.) Price 5*s*. net.

THE author, who is one of the surgeons to the Royal Infirmary of Edinburgh, has compressed into 220 pages a great deal of interesting matter concerning the development of surgery in the northern capital from 1505 down to the period preceding Lister. The origin of this famous school may be said to date from the "seil of cause granted be the Towne Counsell of Edinburgh to the Craftes of Surrengenry and Barbouris" whereby they received permission to dissect one condemned criminal each year "quairthrow we may heif experience, ilk ane to instruct utheris." The principles here laid down to base surgery on anatomy and to teach the same pervades the whole history of the Edinburgh school down to the period of Syme, its greatest representative in the middle of last century.

At first the barbers were eliminated from the surgical craft, which continued for a long period outside the University walls, until in 1726 the University itself established a chair of anatomy, which was first occupied by the race of the Monros, father, son, and grandson. The history of the connection of the Bell family, Benjamin, John, and Sir Charles, is well described, and their creation of a great following, numbering among the flock the representative names of Sir William Fergusson, Robert Liston, and James Syme, a galaxy of practical surgeons of which any medical school might be proud. Lister migrated in early life from University College, London, to become a pupil of Syme, with whom he became intimately associated before returning to London.

It is clearly to be made out in Mr. Miles's book that the path to surgical fame and fortune in Edinburgh was by way of the dissecting-room, and in the pre-anæsthetic times, when rapidity of operation was the order of the day, a very exact knowledge of anatomy was essential. The introduction of anæsthetics altered this, however, although for many years to come surgeons all over the country learned their art as dissectors, and the eminence of our surgeons as practical craftsmen may be referred to this early training in manipulative skill. At the same time, however, English surgery as a science was in a backward state, and there is considerable ground for the belief that part of Lister's great work was due to his training as a pathologist rather than as an anatomist. He became familiar with pathological doctrines and the bacteriology which was then rapidly coming to the front, and most successfully applied the knowledge to the problems of disease which confronted him. In this way he laid the foundations for enormous advances, although he departed from the Edinburgh anatomical traditions.

In comparison with expert craftsmen like Liston, Fergusson, and Syme, Lister was not a brilliant and dashing operator, although his final results have possibly never been surpassed. Under his magic hand the terrors of sepsis disappeared and a new era in medicine was revealed. The preparatory training which Lister went through was not imitated by others to any great extent for a long time, and the great discoveries of bacteriology passed into the hands of pathologists. This must seem strange when it is remembered that the great majority of cases which a surgeon is called upon to treat are the direct or indirect results of infection. The technical developments of operative surgery have tended more and more to make the surgeon an operative craftsman rather than an original investigator. The relative failure of pure surgery apart from science in the present war is a confirmation of this.

As a study of the evolution of operative surgery in Edinburgh Mr. Miles's book is a welcome addition to our knowledge, however. There still is a necessity for a work on the evolution of ideas on surgical diseases as opposed to manipulative skill in their treatment.

OUR BOOKSHELF.

Frontiers: a Study in Political Geography. By C. B. Fawcett. Pp. 107. (Oxford: At the Clarendon Press, 1918.) Price 3*s*. net.

IT would not be easy to say much that is new in a general discussion on frontiers after the works of Sir Thomas Holdich and Prof. L. W. Lyde, one arguing that frontiers should secure protection to the State, the other that they should be chosen rather to facilitate intercourse in the hope of securing peace between adjacent States. Mr. Fawcett has, however, written a very readable essay treating the subject from the viewpoint of geographical evolution. He begins by discussing the value that various features have as frontier zones, and leads on to a consideration of the complexities of the frontiers of modern States. He notes that the strongest force at present working towards the modification of frontiers is a tendency towards the coalescence of national and political boundaries. This implies a subordinate place to economic and strategic considerations, though in the main such frontiers will conform with the latter. The real difficulties arise in the determination of nationality in frontier lands which are well peopled. We are glad to notice that Mr. Fawcett defines his use of the terms "frontier" and "boundary," employing the former for an area and the latter for a line. Loose usage of these terms is not conducive to clear thinking. His suggestion to speak of zones of separation and zones of intercourse (or of pressure), instead of natural and artificial frontiers, has much in its favour. Among his wealth of instances we find no mention of the neutral zone established in the south between Norway and Sweden in 1905. Here is an instance of a frontier of intercourse (short compared with the long zone of separation) which both nations agree to prevent so far as possible developing into a menace to one another, by prohibiting the erection of military works or the establishment of garrisons.

R. N. R. B.

Story-lives of Men of Science. By F. J. Rowbotham. With portraits and other illustrations. Pp. 266. (London: Wells Gardner, Darton, and Co., Ltd., n.d.) Price 3*s*. 6*d*.

THESE attractively written biographies of some seventeen workers in science will interest young readers, and probably indirectly foster a love of natural knowledge among them. Among the heroes of science chosen by the biographer may be mentioned Galileo, Newton, Davy, Faraday, Darwin, Pasteur, Kelvin, Lister, and Crookes. The chapters are full of incident, and deal with the domestic lives as well as with the researches of the great men chosen for inclusion in the volume. Mr. Rowbotham shows a wide acquaintance with the literature of his subject, and possesses a happy style. It is unfortunate that throughout the chapter on Lord Kelvin "Thompson" is printed instead of "Thomson," and that Francis Bacon appears in the table of contents as Lord Bacon, instead of Lord Verulam.

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.*]

"Bread-crust" Volcanic Bombs.

IT is easy to identify the writer of the friendly notice of Dr. Tempest Anderson's "Volcanic Studies" (second series) in NATURE of April 18, but, notwithstanding his high authority, I must adhere to my explanation of "bread-crust" bombs (p. 42), viz. that the cracks are results, not of internal expansion, but of contraction. I had the opportunity of studying a large example near the crater of Vulcano, with others of smaller size in the Lipari Islands, and brought away a "hand-specimen," now in the Sedgwick Museum. The former has a compact and rather glassy "rind" about an inch thick, with an interior full of small vesicles. The cracks vary much in size, and the walls of the shallower converge (are rifts, in the strict sense of the term); they appear to be analogous with the cracks in septaria, etc., and I do not see how the formation of numerous vesicles filled with steam is to increase the volume of the "core" within the "rind," for the process is not comparable with one of effervescence. Simple contraction of the crust seems inadequate, since these cracks, so far as I have seen, do not occur in lumps which are homogeneous throughout.

In regard to admitting into the book some photographs which Dr. Anderson had already used as illustrations, I determined to risk the criticism, because I knew them to be those which he preferred; so that if I had excluded them I should have had to select from the less valuable group, and I was anxious to obtain a representative series. T. G. BONNEY.

IT is certainly not without diffidence that any British geologist will venture to question Prof. Bonney's interpretations of volcanic phenomena, but in this case he is clearly in opposition not only to received opinion, but also to well-established facts.

A "bread-crust" bomb has a thin, compact rind broken up into polygonal areas separated by cracks. The interior is usually highly vesicular, and even pumiceous. An important point is that the cracks in the crust frequently gape as if they had been opened out, and into them the spongy matter of the interior has sometimes risen up in such a manner as to suggest that expansion has taken place after the crust solidified.

Prof. Lacroix, in his monograph on "La Montagne Pelée" (p. 523), has given an excellent account of them. "The concentric arrangement of these bombs and the structure of their crust, different from that of their interior, must be explained in the following manner. When a portion of the magma at a very high temperature is projected in a pasty condition the surface rapidly cools, expelling the gases which it contains. Thus the glassy crust is formed; this occupies a smaller volume than when molten, and cracks from contraction, but at the same time the centre of the bomb, cooling more slowly beneath the protecting crust, gives off its gases only gradually. As the solidifying glass becomes more viscous these gases occasion the production of vesicles of varying size, which increase the volume of the bomb. By the conflict between the contraction of the periphery and the expansion of the centre, 'lips' are produced, and the fragments of the carapace are displaced as shown in plate xxiii." On p. 522 he explains the term "lips" as signifying open cracks in "bread-crust" bombs, with the edges more or less everted like the leaves of a book.

Prof. Mercalli, in his text-book of vulcanology, one of the best and most recent ("Volcani Attivi," p.110), gives practically the same explanation, and states that these bombs are sometimes called "bombe gonfiati" (bombs that have swelled). Mercalli does not share Prof. Bonney's unwillingness to admit that the molten material in bombs may effervesce, for he describes "exploding bombs" that are ruptured with violence by the expulsion of the gases in the magma, and cites as authorities Prof. Ricco and Sir William Hamilton.

The name was originally given by Prof. Johnston-Lavis (NATURE, vol. xxxix., p. 110, and Proc. Geol. Assoc., vol. xi., 1890, p.392). He states that "expansion causes cracking of the hardened crust, and in some cases protrusion through the crust." His explanation refers to the bombs of Vulcano (to which Prof. Bonney's description also refers), and was accepted by Prof. Hobbs (*Zeits. Deut. Geol. Gesell.*, vol. xlv., p. 579) and by Prof. Bergeat ("Die Aeolische Inseln," p. 185), both of whom know the island well, and have made careful study of the petrology of these bombs.

References might be multiplied if that were desirable, but sufficient has been said to prove that among English, French, American, Italian, and German geologists who have had every opportunity of observing the facts, the explanation adopted by the reviewer is generally regarded as the only satisfactory one.

J. S. F.

Recovery of Speech through Excitement.

PUBLIC attention has recently been directed to several remarkable examples of recovery of speech by shell-shocked soldiers as the result of unexpected excitement. Your readers may be interested to learn that a very remarkable instance of the loosening of the tongue occurred several thousand years ago, namely, in the case of the afflicted son of Crœsus, King of Lydia. Cyrus, the Persian, besieged and took Sardis 548 B.C., and Herodotus, writing approximately one hundred years after the event, tells us that "when the town was taken one of the Persians was just going to kill Crœsus, not knowing who he was. Crœsus saw the man coming, but under the pressure of his affliction did not care to avoid the blow, not minding whether or no he died beneath the stroke. Then this son of his, who was voiceless, beholding the Persian as he rushed towards Crœsus, in an agony of his fear and grief burst into speech, and said, 'Man, do not kill Crœsus.' This was the first time that he had ever spoken a word, but afterwards he retained the power of speech for the remainder of his life." (Herodotus, book i., chap. lxxxv., translated by Rawlinson.)

J. NEWTON FRIEND.

London, May 6.

THE PROMOTION OF POST-GRADUATE WORK AND RESEARCH.

THE Senate of the University of London has had under consideration proposals which have emanated from the Conference of Canadian Universities held in May, 1916, the Conference of Universities held on May 18, 1917, and the American Association of University Professors. The object in view is to encourage post-graduate work and research and to contrive some means of strengthening the ties between the universities of Britain and her dependencies and those of the

Allied nations, especially the United States of America. The chief proposal consists in the institution of a new doctorate to be attainable by students who have taken a lower degree in some overseas university. The Senate at its meeting on January 23 considered the question of provision for the needs of graduate students from afar, and resolved that the report of the Academic Council be approved and adopted. The first item in the report declares that "it is undesirable to institute a doctoral degree of a lower standard than the existing doctoral degrees."

It may assist those who are not familiar with existing regulations to form an opinion on this subject if they are reminded that the M.A. and M.Sc. already exist intermediate between the first degree of Bachelor and the final degrees of D.Litt. and D.Sc., and that the degree of Master is awarded on the results of research undertaken by the candidate.

It would be impossible in the space here available to set forth all the arguments which might be used for and against the proposed new doctorate. No doubt many of the existing Doctors of the University of London would be opposed to any change of the kind indicated, which would appear to offer easier terms to other students than were imposed on themselves. But those who are intimate with the working of the regulations for the doctorates of the University of London know that these degrees have been awarded in the past on candidates of very unequal merit. In fact, there can be no doubt that there is as much difference among them as would be at all likely to exist between the old and the suggested new doctorates. The D.Sc.'s, for example, include the survivors of the old régime when a stiff examination was the only test, but the list includes some famous names. Since the alteration of the regulations, so as practically to do away with examination and require only the production of a thesis, the quality of the graduates has not appreciably improved, to judge by their average achievements. The reason for this is not far to seek. If in every case the ideas embodied and illustrated in the work set forth in the thesis were those of the candidate himself, the case would perhaps be otherwise. But this is rarely, if ever, true, for the practice has been for the candidate to go to his professor for a subject and to work it out under his supervision. This is the plan long adopted in the German universities with respect to the Ph.D. degree, and the only difference which has grown up since the institution of the degree in London is the extension of the time which is required to elapse between the stage of Bachelor and that of Doctor. The fact is, the attempt to maintain the very high standard originally aimed at has been distinctly a failure. No one can now say exactly what the D.Sc.(Lond.) implies. At Oxford and Cambridge the Doctorates in Science are given under quite different conditions, after the lapse of a much longer interval of time, and on the evidence of published work implying mature study and research and an established reputation. These degrees, therefore, are not comparable with those of London.

The report of the Academic Council referred to above sets forth a summary of reasons for and against the institution of a new doctoral degree. Under the former head it mentions (1) that it would be the means of strengthening the unity of the Empire by increasing the number of students from the universities of the British Empire who pursue their graduate studies in Great Britain, (2) that it would meet a demand preferred by the Canadian and French universities, (3) that it would increase the number of graduate students from Allied countries, and (4) that it would promote research in this country. On the other hand, it is stated (1) that the establishment of such a degree is not in the interests of real university education, (2) that the abler students come to London on account of the facilities for study and not primarily to get an English degree, (3) that the establishment of the doctorate might cause the masterships to disappear altogether, and (4) that the establishment of the degree would affect prejudicially the standard of the existing doctorates and so injure the University.

Of all these considerations it appears to the writer that the first is, at the present time and probably for generations to come, of greatly preponderant importance. And in declining the proposals which come to it from his Majesty's Dominions beyond the seas the Senate has missed a great opportunity for the development of the University.

Students who come to London for the purpose of advanced study and research are attracted doubtless to some extent by the facilities afforded by museums, libraries, and laboratories. But in future, if the lessons of the past have not wholly failed to influence university authorities in this country, university professorships will be filled everywhere by men who have shown by their work and teaching that they are qualified and eager to advance knowledge in their respective subjects, and the abler students will go to the abler teachers. Schools of thought can be created only in this way, and in this way chiefly will research be promoted. Degrees have very little to do with the matter, and the sooner the student desirous of doing research is out of tutelage the better. The old doctorates at Oxford and Cambridge are in the nature of honorary degrees, and it will be better to keep them so.

Meantime, Oxford has already instituted a new degree—namely, Ph.D.—which is to be given to students who have carried out a special course of study or research extending over a period of two to three years at least under the direction of one of the Boards of Faculties, and have satisfied the examiners that their work constitutes an original contribution to knowledge and is of a sufficient standard of merit.

It is within the experience of every man more than forty years of age that the quality of his doctorate, if he is a Doctor in Science or Letters, matters very little to himself or to the world. If there is anything of value in the man it is already showing itself in the position he has attained or in the quality of the work he is doing, and is due to the endowment of Nature. If it cannot be said that he has accomplished anything, and if it is obvious that he is occupied in an inferior line of work, it seems all the more to cast discredit on the process by which he obtained his degree.

W. A. T.

ANCIENT PLANT-NAMES.[1]

THE antiquity of plant-names needs no proof. We read in Genesis how man, early in his career, came to designate living things, and learn the name of the tree from which he improvised his first raiment. Semitic tradition is corroborated for other regions by Chinese ideographs which admit of comparative study and by Aryan vocables that lend themselves to ethnic generalisation.

The results of the study of ancient plant-names are only satisfactory when the incidence of the names is assured. But assurance is not easily attained. The work calls for the exact knowledge of the scholar, the historian, the ethnologist, and the naturalist. The requisite combination cannot always be secured.

There are, too, certain intrinsic difficulties. Names identical in significance are not always applied to one plant. The *tournesol* of France and the *girasole* of Italy belong to separate natural families, the *heliotrope* of Greece to a third. Words linguistically equivalent may connote distinct species. The *sarson* of Hindustan and the *sarisha* of Bengal are different crops, both equally prevalent in either country; the *sarshaf* of Persia is akin to, but distinct from, each.

The position of classical plant-names was that of plant-names to-day. Theophrastus, oldest in time, yet most modern in method, of Greek botanists, taught his pupils that most cultivated plants had names and were commonly studied, but that most wild kinds were nameless, and few knew about them. Yet European study of ancient plant-names is mainly that of Greek ones. As Sir W. T. Thiselton-Dyer has pointed out in Whibley's "Companion to Greek Studies," the Greek botanist had a name for every conspicuous Greek plant, and most of these names have come down to us, whereas nothing of the kind, if it ever existed, has survived from the Romans.

Renaissance students endeavoured to identify the plants described by Dioscorides. Their texts show great critical acumen; their illustrations are often most faithful. Yet much of their work is obsolete. Their appreciation of the principles of plant-distribution was imperfect. They sought in Central Europe for Mediterranean species, and often were in error when they felt most assured. It took the European naturalist three centuries to realise this; even yet the European scholar does not always appreciate the situation, and standard lexicons sometimes still remain "blind leaders of the blind." Until, two years ago, Sir W. T. Thiselton-Dyer gave us a compact enumeration of those plants actually Greek with which it is possible to wed a Greek name, no scholar and no naturalist in this country had any real assurance as to the accuracy of any accepted identification.

The same author has now, in the paper cited in our footnote, dealt with a special group of ancient plant-names, mostly Greek. With a restricted arable area and an extended seaboard, ancient Greece possessed an adventurous mercantile marine. The list of Greek names for cultivated edible, officinal, and coronary plants, or for wild species of economic interest was supplemented by one of names for plants or plant-products imported from abroad. The resolution of such exotic names is, not unnaturally, often most perplexing.

The aid this new contribution to the subject renders to the scholar and the naturalist cannot well be measured. Both can best repay their obligation by studying it with care. The space at our disposal forbids any attempt at its analysis. The account of ἄμωμον and καρδάμωμον, terse yet complete, carries instant conviction. The problem of the Idæan vine, the solution of which by Dodoens three and a half centuries ago has, as the author explains, been generally overlooked, amply merits restatement. But the other sections equally deserve unstinted praise. It may yet be necessary to modify in detail the conclusions reached regarding ὀποκάλπασον. This cannot, however, lessen the value of a note which manifestly puts the special student on the real track of this elusive bane, and gives the scholar something better than the old lexicographic acceptance of its identity with an innocent gum. The traveller responsible for that self-contradictory conclusion could justify it only by the assumption that Galen had been misled. This note may also spare us the repetition of a contrary suggestion, less consonant with phytogeographical considerations than anything ever hazarded by a Renaissance scholar, that in ὀποκάλπασον the ancients had somehow come into contact with the West African ordeal-tree.

[1] "On Some Ancient Plant-names." III. By Sir W. T. Thiselton-Dyer, K.C.M.G. *Journal of Philology*, vol. xxxiv., pp. 290–312.

WATER-POWER IN GREAT BRITAIN.

THE absence of co-ordination and systematic control in regard to the water resources of this country has frequently been alluded to in the columns of NATURE when reviewing the voluminous reports and statistics issued by hydrological departments on the Continent and in the United States. It is satisfactory to observe that this regrettable indifference to a matter of urgent national importance has at length become the subject of comment and discussion. At a meeting of the Royal Society of Arts on January 23, Mr. Alexander Newlands, engineer-in-chief of the Highland Railway, read a paper reviewing the water-power resources of the United Kingdom (with special reference to Scotland), estimating their extent and economic value. He pointed out that the situation created by the war had intensified the national interest in questions of economic importance, and that the abuse and neglect of the natural resources of this country were now being closely investigated, as evidenced by the report of the Coal Conservation Committee. Coal is certainly at present, and will probably be for some time to come, our principal source of power, but it should not be overlooked that 1 cubic foot of water per second falling through 11 ft. can supply a horse-power unit to any modern turbine. The past neglect of the water resources of the country is, therefore, an economic waste which should not be tolerated any longer. Of a total of 10½ million horse-power generated in industrial engines in 1907 in Great Britain and Ireland, only about 180,000, or 1·6 per cent., was attributable to water.

Unfortunately, few of the larger English rivers are trustworthy enough in discharge, or possess sufficient intensity of fall, to render them utilisable to any great extent. On the other hand, there are large rivers in the Scottish Highlands which have falls of 14 ft. to 16 ft. per mile, and several Irish rivers have very considerable falls almost at the points where they enter the sea. Scotland, particularly the region which lies north of the Forth and the Clyde, possesses greater potentialities of supply than any other part of Great Britain. Taken as a whole, it has the greatest rainfall, the only localities comparable with it being Seathwaite, in Cumberland, and Snowdon, in Wales. (An annual rainfall of 160 in. has been recorded on Ben Nevis, 182 in. in Cumberland, and 193 in. on Snowdon.)

Mr. Newlands computed that in Scotland—chiefly in the Scottish Highlands—there are about 11,500 sq. miles of country with a rainfall of 50 in. or more, as compared with 3360 sq. miles in England, 3390 sq. miles in Wales, and 5910 sq. miles in Ireland. By impounding the discharge from the lock basins, and assuming an average rainfall of 42 in. (representing a yield from the catchment area of 3 cubic feet a second per sq. mile), of which two-thirds, or 28 in., would be available for power purposes, he estimated that the supply in Scotland would amount to 375,000 horse-power in round figures. This is exclusive of the basins of the Clyde, the Forth, and the Tweed, on account of their other important interests, and of rivers and small streams. By diversions and the linking-up of adjoining catchment areas, and by impounding in excess of the quantity provided for in the estimate, it might be assumed that for, say, 100 days' supply 650,000 horse-power would be available.

According to the figures of Mr. Archibald Page, of Glasgow, the power requirements of Scotland in 1916 were 1,119,000 horse-power units, and it would appear, therefore, that there is sufficient water-power in the Scottish Highlands to meet a large proportion of this demand, though it is doubtful whether, after development and transmission to existing industrial areas, the cost would be less than that of power generated there at the pit-head. One of the most interesting features of this water-power was that it existed in a territory destitute of coal.

In surveying the situation in regard to England, Wales, and Ireland, Mr. Newlands remarked that the absence of large lochs and the lack of sufficient elevation in the country as a whole detracted from the possibilities of any great development of water-power, which, so far as it was available, would have to be derived from river-flow. The paper concluded with a plea for more support and recognition of the work of the British Rainfall Organisation and of the Scottish Meteorological Society than those bodies receive.

Brysson Cunningham.

SOME AMERICAN VIEWS ON AERONAUTICS.

On April 14, 1917, the American Philosophical Society held at Philadelphia a "Symposium on Aeronautics," of which the papers are now published in the society's Proceedings (vol. lvi., No. 3).

The titles of some of the papers contributed to the conference—namely, "Dynamical Aspects," by Prof. A. G. Webster; "Physical Aspects," by George O. Squier; "Mechanical Aspects," by Dr. W. F. Durand; "Aerology," by William B. Blair; and "Engineering Aspects," by Dr. Jerome C. Hunsaker—show that every attempt was made to ensure a thoroughly representative discussion. But in reviewing the proceedings one cannot help being struck with the opinion that modern aeronautics is too straggling a subject or collection of subjects to be dealt with efficiently in a meeting of this character. Thus, Dr. Webster, the author of a standard treatise on "Rigid Dynamics," reproduces certain familiar diagrams of lines of flow and explains the meaning of lift and drag; Mr. Squier tells us that in the past few years several elements, helium, argon, neon, krypton, and xenon, have been found in the air; Dr. Durand enumerates the problems which have to be solved in the development of the aeroplane—problems more often enumerated than solved; while in Mr. Blair's paper a large amount of space is taken up with twelve diagrams, although he fails to explain what connection these figures have with the mean of wind observations in "Highs" and "Lows," or what the different parts of the diagrams represent. The three pages which Dr. Louis A. Bauer devotes to his subject refer to difficulties attending the use of the compass in aeroplanes arising from deviations of the apparent vertical due to normal and other accelerations.

An original composition to the programme of the meeting is represented by Prof. Edwin B. Wilson's second paper on "The Theory of an Aeroplane Encountering Gusts." The first of these papers was published in 1915 by the American Government Advisory Committee. Together the two constitute a mathematical extension of the theory of small oscillations from free to forced oscillations. Apart from any questions as to how best to deal with the gust problem, the study of the forced oscillations of an aeroplane is a problem proposed for solution many years ago, which has to be solved sooner or later in the development of the aeroplane, and the sooner the better. Of course, the treatment is limited to the consideration of small disturbances, but we believe it was Mr. Bairstow who, in the earlier days of his experiments, pointed out that a theory so formed might give useful approximations for practical purposes, just as our knowledge of the pendulum was largely based in the first instance on the study of oscillations of small amplitude. It will be seen that both longitudinal and lateral disturbances are considered, although the inconvenient notation renders it a little difficult to know what is longitudinal and what lateral, or even whether the aeroplane is supposed to be flying forwards or backwards. An alternative method of treating gusts has been developed and worked out by Mr. Brodetsky in this country, although only his first paper has yet appeared in print.

The value of mathematical work of this kind has been called in question by certain meteorologists who have claimed that theirs was the proper method of solving the problems of aviation. A study of the present collection of papers, however, shows that while meteorological investigations are required to ascertain the conditions under which flights are made, it is necessary to resort to very long, hard mathematical calculations in order to ascertain *how* these conditions can be met in the construction of a flying machine. Of course, work such as that of Prof. Wilson requires developing from the experimental side, but the mathematics must be done previously. G. H. B.

NOTES.

THE present position of nitrogen fixation in this country was stated in the House of Commons on May 2 by Mr. Kellaway, Parliamentary Secretary to the Ministry of Munitions, in reply to a question by Sir William Beale. The various proposals for fixing nitrogen have been examined in detail by the Nitrogen Products Committee of the Munitions Inventions Department, and, as a result, intensive research has been concentrated upon the Haber process. A research staff composed entirely of young British scientific workers has accumulated the knowledge requisite to the translation of the vague outlines of this process of ammonia synthesis, as revealed in the patents of the German industrial concerns, into a commercially practicable process. This has involved two years of unremitting laboratory research, during which period numerous departmental patents have been taken out for improvements in ammonia synthesis, as well as in the subsidiary branches of the problem, such as hydrogen manufacture. These patents are held in the names of the members of the research staff, and are assigned to the Secretary of State for War. The research work of the staff of the Munitions Inventions Department is now far advanced, so that the results have been placed at the disposal of the Explosives Department for application on a factory scale. The manufacturing operations will be conducted at present for war purposes, the production of synthetic ammonia being applicable to the manufacture of explosives, as well as to the production of ammonium sulphate for agriculture. The results of the research work on synthetic ammonia have not been made public, but may be communicated confidentially to concerns proposing to erect plant under financial arrangements approved by the Treasury. The availability to manufacturers of the general research work of the staff of the Munitions Inventions Department is now being considered by committees representing the several departments concerned.

THE Gas Traction Committee, appointed in November last to consider the employment of coal-gas as a substitute for petrol and petroleum products in motors, its general safety, and conditions for use, has issued an interim report (H.M. Petroleum Executive, price 1*d*.). This deals chiefly with the present use of gas, mainly at low pressures, in suitable fabric bags; the work is to be continued to cover its use under higher compressions when the necessary appliances and plant are obtainable. The Committee is satisfied that gas can be efficiently, safely, and promptly substituted for motor spirit (only two minor accidents have been reported). Two hundred and fifty cubic feet are considered equivalent to one gallon of petrol, so that gas at 4*s*. per 1000 cub. ft. is equivalent in cost to petrol at 1*s*. per gallon. No restrictions, except in so far as the shortage of coal or other war conditions may demand, should be imposed on the use of gas in suitable containers. A specification for the bags is given; the material should be two-ply diagonally doubled, and proofed with 6 oz. per square yard of proofing containing 90 per cent. of high-class rubber, this being vulcanised by the hot process. The permeability of prepared fabric to hydrogen must not be more than 10 litres per square metre per twenty-four hours (0·3 cub. ft. per square yard per twenty-four hours). The working life of such containers would normally be eight months. Top ventilation should be provided in any garage, and a container should be completely deflated after standing idle for two weeks. For use under higher compression it is undesirable that semi-rigid containers of rubbered canvas should at present be charged to a greater gas pressure than 90 lb., or be of greater internal diameter than 4 in. Encouragement should be given to the construction of semi-rigid containers of rubber and woven wire up to a working pressure of 300 lb., and it is considered desirable to encourage experiments with rigid metal cylinders working up to 1800 lb., particularly in connection with their application to motor-omnibus use and for the transport departments of municipal authorities.

A LETTER to the Press on the subject of food crops and the protection of birds, recently issued by the Royal Society for the Protection of Birds, directs attention to the serious diminution in the numbers of our resident insectivorous birds, due to the severe winter of 1916–17, and also to the widespread destruction of birds and eggs, which is a cause of grave anxiety at the present time. That everything possible should be done to protect and preserve such species is beyond dispute. As the signatories of this letter point out, all are agreed that insect-eating and vermin-eating species of wild birds are invaluable to man. Further, the farmer and fruit-grower have everything to gain by responding to the present appeal to take the matter up promptly with the view of checking the destruction of these birds and their nests and eggs. Plagues of various species of injurious insects have already been reported from different parts of the country, and but for the services of our resident and migrant insectivorous birds these would each year grow worse. As it is, they already inflict very serious losses, and unless there is a large increase in the number of beneficial birds there is always the possibility of their gaining the ascendancy and causing widespread destruction to our home-grown food supplies. At a time like the present, when every acre of food is almost priceless to the country, our agricultural, gardening, and allotment societies and associations might do much to conserve a highly beneficial factor in successful production the importance of which it would be difficult to over-estimate.

BY the death of Dr. Joseph Deniker on March 18, France has lost one of her most distinguished anthropologists. Dr. Deniker, who was in his sixty-seventh year, was born in Russia, and commenced his student's career in Petrograd. Later he went to Paris as a student of anthropology, where his special abilities were quickly recognised, and he was given a permanent place in the school of his adoption. The research which he published in 1885 on "The Anatomy and Embryology of the Anthropoid Apes" is an example of how investigations of that kind should be made. He is best known for the work he did relating to the classification of human races. From 1880 until his death Dr. Deniker gathered data from all trustworthy sources relating to the physical characters of inhabitants of every quarter of the globe, with the view of building up a natural classification of human races. There are few peoples he had not investigated personally. Some of the results of that labour can be seen in "The Races of Man," which he wrote for the Contemporary Scientific Series in 1900. He focussed his attention particularly on the races of Europe, and his various publications dealing with the racial types and the distribution of these types amongst the various nationalities of Europe constitute the most trustworthy sources of information concerning the ethnology of modern Europe. Dr. Deniker also made contributions to our knowledge of the cultural side of anthropology. He held the post of chief librarian to the Natural History Museum in Paris, and did much for the bibliography of scientific literature. He acted as secretary for France in the compilation of the International Catalogue of Scientific Literature. In 1895 the Royal Anthropological Institute of Great Britain and Ireland made Dr. Deniker an honorary fellow, and ten years later invited him to give the Huxley memorial lecture—the highest honour at its disposal.

AT a general meeting of the members of the Royal Institution held on May 6, the following vice-presidents were elected:—Dr. H. E. Armstrong, Sir Wm. Phipson Beale, Bart., the Hon. R. C. Parsons, the Rt. Hon. Lord Wrenbury, the Rt. Hon. Lord Rothschild, Sir James Crichton-Browne (treasurer), and Col. E. H. Hills (secretary).

WE learn from the *British Medical Journal* that the Institute of France has decided to award the Osiris prize this year. The prize is of the value of 4000*l.*, and was founded for the recognition of the most important discovery or work in science, letters, arts, industries, or generally anything for the public benefit. It has been held in abeyance since the beginning of the war.

AN informal meeting of the fellows of the Chemical Society will be held at Burlington House on Thursday, May 16, after the conclusion of the business of the ordinary scientific meeting. Messrs. Adam Hilger, Ltd., will give a demonstration of their method of determining the best temperature at which to anneal glass, and specimens of apparatus will be exhibited by the Dunlop Rubber Co., Messrs. Fuerst Bros., Townson and Mercer, Ltd., and the Scientific Supplies Co.

THE Iron and Steel Institute has awarded 100*l.* from the Carnegie Research Fund to Mr. G. Patchin to enable him to pursue research on "Semi-Steel and its Heat Treatment"; to Mr. J. N. Kilby for research work on "The Basic Open-hearth Process of Steel-making in all its Branches"; to Mr. S. L. Hoyt for the study of "The Foreign Inclusions in Steel, their Occurrence and Identification"; and to Mr. J. A. Vanden Brock for research work on "The Elastic Properties of Steel and Alloys."

THE inaugural meeting of the Gilbert White Fellowship was held on Saturday, April 20. Resolutions proposing the formation of the fellowship and the adoption of its rules were proposed and carried unanimously. Then followed the election of Dr. William Martin as the first president. The list of vice-presidents includes the names of Mr. E. W. Holmes, Mr. W. H. Mullens, Sir David Prain, Prof. G. S. Boulger, Miss Gulielma Lister, Mr. A. W. Oke, and Miss Willmott. The honorary secretary is Mr. W. M. Dunton, 18 Crockerton Road, S.W.17.

THE council of the Royal Society of Edinburgh has awarded the Keith and Neill prizes as follows:—(1) The Keith prize to Mr. R. C. Mossman for his work on the meteorology of the Antarctic regions, which originated with the important series of observations made by him during the voyage of the *Scotia* (1902–4), and has continued to the present time; (2) the Neill prize to Prof. W. H. Lang for his paper, in conjunction with Dr. R. Kidston, on *Rhynia Gwynne-Vaughani*, Kidston and Lang, published in the Transactions of the society, and for his previous investigations on Pteridophytes and Cycads.

AT the annual general meeting of the Institution of Civil Engineers held on April 23, Sir John A. F. Aspinall was elected president for the year 1918–19. The council of the institution has made the following awards for papers read and discussed during the session 1917–18:—Telford gold medals to Sir Robert R. Gales (India) and Mr. E. Sandeman (London); George Stephenson gold medals to the Hon. Sir Francis J. E. Spring and Mr. H. H. G. Mitchell (Madras); and Telford premiums to Mr. W. L. Lowe Brown (London), Mr. G. Blake Walker (Barnsley), and Mr. Alwyne Meade (Blackheath). Indian premiums also have been awarded to Sir Robert Gales and Sir Francis Spring.

THE Secretary of State for the Colonies has appointed a Committee to inquire into and report upon matters relating to research and development in the dependencies of the Falkland Islands, which include South Georgia, the South Shetlands, and Graham Land, with a view to the preservation of the existing whaling industry and the investigation of the economic and scientific possibilities of those regions. The members of the Committee are as follows:—Mr. P. C. Lyon, Department of Scientific and Industrial Research (chairman); Mr. J. O. Borley, Board of Agriculture and Fisheries; Mr. E. R. Darnley, Colonial Office; Dr S. F. Harmer, British Museum (Natural History), and Capt. C. V. Smith, R.N., Admiralty. Communications may be addressed to the secretary, Mr. H. T. Allen, Colonial Office, Downing Street, S.W.1.

THE Government is offering an award of 2000*l.* to the first person or persons who can obtain on or before August 1 next a fuel-oil deemed by the authorities to be suitable for Admiralty use by admixture of dehydrated coal-tar with mineral petroleum oils. The mineral petroleum oils to be employed must be in accordance with the Admiralty specifications for fuel-oil, and may be derived from the following sources:—U.S.A. Gulf fields, U.S.A. Northern fields, Mexico, Trinidad, Persia, Borneo, Burma, and the United Kingdom. The necessary samples of tars and mineral oils will be provided free of charge to responsible persons by the Government. All communications respecting the award should be addressed to the Controller, Munitions Mineral Oil Production Department, 8 Northumberland Avenue, W.C.2.

The Australian Government has published a report (Bulletin No. 6) by its Advisory Committee of Science and Industry on alcohol fuel and engines. A previous report was noticed in Nature of October 18 last. The present report, which is much fuller, gives the result of a considerable mass of experimental work. The numerous ways of obtaining alcohol from various vegetable products are discussed in relation to Australian climatic conditions. An excellent account is given of the effect on stationary internal-combustion engines of the proposed change of fuel; experiments to determine this were carried out in the engineering laboratory of Melbourne University. The main conclusions reached are that the world-supply of liquid mineral fuels is not sufficient to meet the world demand; enterprises for the production of mineral oils in Australia have not so far proved successful; no crops suitable for the production of alcohol are at present grown in Australia in sufficient quantity to meet existing local liquid-fuel requirements; the most suitable crops would be sorghum stalks, cassava, and sorghum grain; and experiments indicate that petrol at 40·5*d.* per gallon is equivalent to alcohol at 30*d.*, so far as fuel costs per b.h.p. are concerned. The Committee decided to recommend that a Government subsidy be granted in order to encourage the proposed new industry.

Major Sydney Harold Baker, of the Gloucestershire Regiment, was killed in action on March 23, aged thirty-seven, and by his death natural science loses an earnest student and an experienced teacher. The son of Mr. James Baker, of Clifton, he was educated at Bristol Grammar School and Jesus College, Oxford, where he held an open scholarship. Graduating with honours in 1903, he continued his reading at Charlottenburg. After a short period at Loretto he became science master at Abingdon School, and entered upon the congenial task of developing his subject in new and handsome buildings. To this he devoted himself with much enthusiasm until the outbreak of war, when he offered himself for service. His promotion was rapid. He became captain in February, 1915, intelligence officer in France in the following September, and major in Salonika in August, 1916. Invalided home early in 1917, after a senior course at Aldershot he was placed in temporary command of an entrenching battalion in France. Here he met his end, after holding a redoubt for thirty-six hours. Major Baker was a man of untiring energy, much personal attractiveness, and great range of interests and knowledge. Few men have combined more successfully the gifts of scientific and of literary training.

By the death of Mr. Donald Salter, on March 22, from wounds received in action, meteorology has lost an earnest worker of great promise. Mr. Salter became a member of the staff of the British Rainfall Organisation in 1908 in his eighteenth year, and, until joining the Royal Engineers early in 1916 under the Derby scheme, was responsible as cartographer for the preparation of the numerous rainfall maps which appeared in the publications of the Organisation. He rendered invaluable assistance to Dr. Mill in the progressive development of the cartographic methods carried on at Camden Square, some of which he himself initiated. Mr. Salter was of an extremely modest and retiring disposition, with a charm of manner that greatly endeared him to his friends. A rapid and efficient worker, he invariably maintained that high standard of accuracy which is a tradition at Camden Square. He had marked artistic tastes, and devoted most of his leisure to their cultivation. After a brief period in the Ordnance Survey Department, Southampton, he saw active service in France until invalided home in October, 1916. Last year he obtained a commission in the Royal Garrison Artillery, and he was mortally wounded while carrying on the duties of section commander near his gun at the beginning of the recent great offensive by the Germans.

Mr. Alfred Gordon Salamon, who died recently in his sixtieth year, will be remembered chiefly in connection with the chemistry of brewing, to which he made various original contributions. His main service to brewing, however, was rendered less by original research than by the interpretation and direction of the practical applications of chemical knowledge among brewers at a time when the art of brewing was only gradually emerging from conditions mainly empirical. Many members of the Royal Society of Arts will remember his Cantor lectures on yeast, which helped to make known in this country the classical work of Hansen, and he was successful as an early advocate of the use of raw grain as an adjunct to malt in the brewery. Mr. Salamon contributed to the Transactions of the Institute of Brewing (of which he was elected president in 1907) papers on this subject and on experiments in malting, and to the Journal of the Society of Chemical Industry papers on the influence of phosphates in fermenting worts and on the manufacture of caramel. He was joint author of a successful process of gas purification by the removal of sulphur by the use of "Weldon mud," and also of processes connected with the manufacture of cyanides; and he did some technical work in connection with the manufacture of artificial perfumes. He had at one time a large practice as a brewers' analyst and consultant, but during later years he devoted himself more to general technical chemistry, especially in its legal aspects. He possessed a keen forensic instinct, and his advice and help in unravelling chemical puzzles arising in connection with patent-law disputes were valued by leading members of the Bar who were more particularly connected with this branch of litigation. Mr. Salamon was for two years chairman of the London Section of the Society of Chemical Industry, in which he took a very active interest, as he also did in the Institute of Chemistry, of which he had for many years been, and was still up to his death, the honorary treasurer. He was popular in his profession, and will be mourned by a wide circle of chemical friends not only at home, but also on the Continent and in America.

Spring this year has somewhat resembled that of last year, except that the early days of May this year have been much colder. The reports issued by the Meteorological Office show that the cold spells which have prevailed with such persistence in London have been common over the whole of the British Islands. March was, for the most part, dry, mild, and sunny; the mean temperature at Greenwich was 44°, which is 2° above the average, and 5° warmer than March, 1917. The mean temperature for April this year was 45°, which is 3° below the average, but 2° warmer than April last year. The warmest week since the commencement of spring is the week ending March 23, when at Greenwich the mean temperature was 48·2°, which is 5·4° above the average. The week with the greatest deficiency of temperature is the week ending April 20, when the mean was 40·4°, with a deficiency of 6·9°; during this week the rainfall at Greenwich measured 1·79 in., which is 0·2 in. more than the average for the whole month. In London, at Tulse Hill, in a Stevenson's screen, the maximum thermometer only rose to 60° or above on three days in April, and the highest temperature was 63°; whilst in March there were seven such warm days, and the highest temperature was 69°. April this year was peculiarly sunless, and this, coupled with the low temperature, kept vegetation throughout the month greatly at a standstill.

The first of a series of articles descriptive of the machinery of the S.S. *Wulsty Castle* appears in *Engineering* for May 3. This, the first seagoing vessel fitted in this country with steam turbo-electric propelling machinery on the Ljungström system, ran her trials on the North-East Coast last week. In the Ljungström turbine the flow of the steam is radial, and the arrangement differs from other turbines, in which fixed and moving blades alternate, in that both sets of blades revolve in opposite directions. Hence a high relative speed can be obtained without excessive shaft speed. In this ship there are two turbo-alternators, each developing 625-kw. three-phase current at 650 volts, 60 cycles per second, at 3600 revolutions per minute. These supply current for two main induction motors, coupled to the single propeller shaft through double helical gearing. These motors are together capable of delivering 1500 shaft h.p. continuously at sea with a propeller speed of about 76 revolutions per minute, and also of driving the ship ahead or astern at full power. The auxiliary machinery is for the most part electrically driven. The boilers are fitted with Schmidt superheaters, and supply steam at a temperature of 625° F. The Ljungström turbine has been proved to have a high efficiency, and Sir William Beardmore has taken the initiative in this country in its marine applications.

In Prof. H. C. H. Carpenter's presidential address to the Institute of Metals reference was made to the work of the Corrosion Research Committee, which is investigating the corrosion of brass marine condenser tubes by salt water. A laboratory specially designed and equipped for the work has been installed in the metallurgical department of the Royal School of Mines, and the experimental plant has been removed from Liverpool to the Southwick power station at Brighton, and is being run under strictly practical conditions. It has also been rendered possible for the committee to arrange that the problem should be attacked in the laboratory *ab initio* with pure metals corroding under the simplest conditions, and this should greatly enhance the value of the work being done. Prof. Carpenter also sketched in outline the most suitable educational course for the metallurgical engineer, and emphasised the point that the training cannot be wholly undertaken at a technical school or university. On completing his college course and entering works, it should be the function of the works to find out what special aptitudes the student possesses. He should have sufficient time to become acquainted with the practice of each of the operating departments, to find his feet, and to acquire the works atmosphere. A discerning management will have little difficulty in judging how best to utilise the services of such a man after this probationary period, during which he should be paid, at any rate, a living wage.

An interesting article appears in the *Fortnightly Review* for May under the combined authorship of Mr. Claude Grahame-White and Mr. Harry Harper. The title is "Sovereignty of the Air and its Relation to Civil Aerial Transport," and the authors discuss the conditions which should be adopted for the regulation of air traffic after the war. Three plans are considered: the air may be completely free to all; it may be under the sovereignty of the country over which it lies; or a combination of these is possible by making the air free to all only above a specified altitude. It is pointed out that if war could be abolished by international consent, a free air would be the best solution. It is, however, fairly obvious that, for at any rate some years after the declaration of peace, the nations will be forced to take strong defensive measures in the air, and the only solution of the problem rendering this possible is a complete sovereignty of the air. The authors are of the opinion that commercial aeronautics will make great advances in the near future, and that the rapid inter-communication possible by the use of aircraft will do much to foster the development of friendly sentiments among the nations, and so to advance progress towards the goal of universal peace. They suggest also the desirability of a universal language to facilitate international relations in general, and this is certainly a point which cannot be overlooked. The whole question of international relations after the war is one of absorbing interest, and the article under discussion is worthy of perusal by those whose thoughts turn to the aeronautical side of such relations.

At the annual general meeting of the Society of Glass Technology, held at Sheffield University on April 17, Mr. Frank Wood, the president, compared the position of the glass industry to-day with that before the war. Dealing with various sections, Mr. Wood said that the quality of British table and decorative ware is supreme, but owing to competition the output is almost negligible. Given three years' freedom of action, the position of the manufacturers would be unassailable. The plate- and window-glass trade is developing, and the outlook for optical glass is hopeful, but it is very necessary that the country should be rendered independent of foreign supplies of the latter; similarly with chemical glass, electric bulbs, and pressed ware, in which good progress has also been made. The production of bottles and jars—the largest section—is in a very healthy position, due to the introduction of new machinery. The president also stated that with united action amongst masters and men of all sections he has every confidence in the future of the industry. He then referred to the raw materials used by the industry, giving statistics and discussing the degrees of purity required, and concluding with some interesting remarks on devitrification. The contents of tank furnaces are subject to devitrification on a large scale; this is known as "dogging." A certain amount of "dog" serves to protect the tank-bottom, but in excess it gives rise to difficulties which seriously affect output. The formation of "dog" may be checked by increasing the proportion of alkali or of alumina in the batch. However, the addition of alkali, besides increasing the attack on the sides and roof of the tank, reduces the durability of the resultant glass, whereas the addition of alumina, with less attack on the tank, gives a more durable and tougher product.

In response to the wishes of the American refrigeration industries, the Bureau of Standards at Washington has undertaken to redetermine the thermodynamic properties of ammonia, and three papers have recently appeared in the Bulletin of the Bureau, by Messrs. N. S. Osborne and M. S. Van Dusen, on the specific heat of liquid ammonia, on the heat which must be given to the liquid to keep its temperature constant when the pressure to which it is subjected is changed, and on the latent heat of vaporisation of the liquid. The heat in each case is supplied electrically, and the change of temperature measured by means of a platinum resistance thermometer. Under saturation conditions the specific heat of the liquid varies from 1·06 calories per gram at −40° C. to 1·10 at 0° C. and to 1·16 at 40° C. The heat measured in joules per gram, which must be abstracted from the liquid, when the pressure is increased by a kilogram per sq. cm. in order to keep the temperature constant varies from 0·06 at −40° C. to 0·09 at 0° C. and to 0·15 at 40° C. The latent heat of vaporisation in calories per gram varies from 332 at −40° C. to 302 at 0° C. and to 263 at 40° C. It is to be hoped that these results will soon be made available to refrigeration engineers in the form of a total heat-entropy chart.

A simple chart for the conversion of temperatures from the Fahrenheit to the Centigrade scale, or *vice versa*, has recently been issued by the Cambridge Scientific Instrument Co., Ltd. The device consists of the two scales side by side in the form of a spiral, and is printed on a card about 1 ft. square. The effective length of the scales is thus about 6 ft., thereby permitting the divisions, which correspond with 2° each, to be satisfactorily open without at the same time restricting the range. This covers from the absolute zero, −273° C., to 2000° C. Both the Fahrenheit and Centigrade scales are divided to 2° to prevent confusion, and each interval of 10°, 50°, and 100° is clearly marked to facilitate easy reading. The chart should prove of service to all users of pyrometers or other temperature-measuring instruments, as both scales are so generally employed that conversion from one to the other cannot in practice be avoided. In addition to the conversion chart, tables of useful thermometric data are given. The Cambridge Scientific Instrument Co. states that it will be pleased to forward a copy of this chart free of charge to anyone interested on receipt of six penny stamps to cover the cost of postage.

The report of the National Union of Scientific Workers for the quarter ending March 25 last outlines the progress which has been made with the work of organisation of the society. Eight branches of the union have been definitely formed in various parts of the country, the prospective membership of which appears to be between 300 and 400. An organising sub-committee is being set up to deal with the London area, which, the report says, presents special difficulties. Among the aims of the union specified in the report is the maintenance of the freedom and independence of research. All inquiries respecting the work of the union should be addressed to the secretary, Mr. Norman Campbell, North Lodge, Queen's Road, Teddington.

A new series of books on industrial chemistry, edited by Dr. S. Rideal, is announced by Messrs. Baillière, Tindall, and Cox. It is intended to give in it a comprehensive survey of the chemical industries. Two volumes have just been issued. "Industrial Electrometallurgy," by Dr. E. K. Rideal, and "The Application of the Coal Tar Dyestuffs," by C. M. Whittaker, are in the press. Further volumes will deal with "The Industrial Gases," "Silica and the Silicates," "The Rare Earths and Metals," "The Iron Industry," "The Steel Industry," "Gas-works Products," "Animal Proteids," "Organic Medicinal Chemicals," "The Petroleum Industry," "Fats, Waxes, and Essential Oils," "Synthetic Dyes," "Wood and Cellulose," "The Carbohydrates," and "Rubber, Resins, Paints, and Varnishes."

The April issue (No. 64) of Mr. C. Baker's Classified List of Second-hand Scientific Instruments has just reached us. In consequence of the increasing difficulty in obtaining new apparatus, it should be of especial interest and service to scientific workers. Copies can be had upon written application to 244 High Holborn, W.C.1.

Messrs. Dulau and Co., Ltd., 37 Soho Square, W.1, have just issued a Catalogue (No. 72) of 764 books—some scarce—on botany and horticulture, anthropology, ethnology, archæology, scientific travel, etc. The list will doubtless be interesting to many readers of Nature.

OUR ASTRONOMICAL COLUMN.

Photographs of the Spectrum of Venus.—In a recent report to the Royal Astronomical Society (Monthly Notices, vol. lxxviii., p. 278) Mr. J. Evershed gives a preliminary account of some photographs of the spectrum of Venus which have been obtained with the large grating spectrograph at Kodaikanal. The primary purpose of the investigation was to ascertain whether the general shift of the lines towards the red at all points on the visible disc of the sun affects also a hemisphere turned 90° or more from the earth. If the wave-lengths in the light from Venus, after correction for the motion of the planet as a whole, are found to be identical with those from ordinary sunlight, the solar displacements cannot be attributed solely to motion of the absorbing gases; but if the Venus spectra show a smaller wave-length, a general motion of the solar vapours away from the earth may reasonably be inferred. Five good photographs, with iron arc comparisons, were obtained in October, 1917, which agree with a previous series of plates taken during February, 1917, in showing a distinctly smaller wave-length for iron lines in the spectrum of Venus as compared with the corresponding lines in the control spectrum of daylight. The results thus favour the motion interpretation of the solar shifts, involving an earth effect; but as the February plates were possibly not entirely free from pole effects in the arc, confirmatory evidence will be sought during June and July next. The trustworthiness of the plates for the purpose in view is indicated by the fact that the combined results from the east and west elongations yield a value for the solar parallax which differs only very slightly from that adopted in the Nautical Almanac. Only one plate was obtained when the planet was at half phase or less, but this is of special interest as showing a discrepant velocity, which is difficult to account for except by supposing that Venus rotates in the same direction as the earth and with the same order of velocity. It is further expected that the Venus plates will eventually decide whether the sun's gravitational field is concerned in the solar line-shifts or not.

Radial Velocities by Objective Prism.—The great advantages offered by the objective prism in the photography of stellar spectra have led to numerous attempts to utilise this instrument for the determination of radial velocities. The spectra of stars down to the tenth and eleventh magnitudes can be photographed in this way, and since a great number of spectra appear on a single plate, even an approximate method of deriving radial velocities would clearly be of great value in connection with the problems of stellar motions. One of the most promising methods appears to be that suggested by Prof. R. W. Wood, in which the light from the stars is passed through a filter of neodymium chloride. In this way each of the stellar spectra is made to show a narrow artificial absorption line at λ 4272, which serves the purpose of a comparison spectrum from a source at rest. An exhaustive test of the accuracy attainable by this method has recently been made by Mr. T. S. H. Graham, making use of a photograph taken at the Harvard College Observatory (Journal R.A.S., Canada, vol. xii., p. 129). Twenty spectra were included in the measures, and four independent sets of measures and reductions were made. The different results obtained from the four series indicate a somewhat greater probable error than the 10 km. per sec. previously estimated by Kapteyn and Campbell. Full and interesting details of the procedure are given in the paper, and attention is directed to the various sources of error, of which even the partial elimination would lead to results of great value.

RECENT MARINE BIOLOGY.

THE December issue of the Journal of the Marine Biological Association contains several papers of exceptional interest. One of these, by Dr. Allen and Mr. Sexton, gives a detailed account of experiments with reference to the inheritance of eye-colour in Amphipods, and in a further paper Dr. Allen presents the general results in a very attractive manner. *Gammarus chevreuxi* had been maintained in the laboratory aquaria for several years, and, quite suddenly, in the third generation of a family of these animals, a striking mutation occurred. Normally the eye possesses black pigment, beneath which is chalk-white matter, but in some individuals of this family the black was replaced by red. A pure black-eyed stock which bred true for three years was mated with a red-eyed stock, which again bred true for five generations. Black behaved as dominant, and red as recessive, and the results of further breeding were in very close correspondence with Mendelian theory. Thus black hybrids carrying red were mated together, giving 4393 offspring, and 3327 of these were black and 1066 red. (The expected results are 3294 and 1098). In the course of the experiments a second mutant appeared in which there was neither black nor red pigment in the eye, but only the deeper-lying chalk-white matter. This albino condition was also transmitted in very close correspondence with expected Mendelian results. Yet a third mutant was observed, a condition in which the chalk-white pigment was absent, and this "no-white" variety behaved as a recessive to dominant white and also closely followed Mendelian laws of numbers. Thus there was a gradual loss of factors, and accompanying the process of albinism there was degeneration of the ommatidia of the eye, a tendency towards the production of such a condition as that exhibited by the various blind species of subterranean Amphipods.

In another paper Dr. Allen gives a general account of experiments with reference to the cultivation of diatoms, describing the methods employed by himself and Mr. Nelson in order to obtain pure cultures. In some of these experiments a normal artificial sea-water was employed, as similar in composition as possible to natural sea-water, and made from pure chemicals. The silica necessary for the growth of the diatom frustules was found to be obtainable from the glass in which the cultures were kept. Sometimes this culture fluid succeeded and sometimes it failed, and it was found that it always succeeded if it was inoculated with from 1 to 4 per cent. of *natural* sea-water. Some growth stimulant was, therefore, present in sea-water, and it was found that this substance could be replaced by a very small amount of an infusion of the green seaweed Ulva. The infusion could be evaporated to dryness and ignited to 200° C. without losing its activity, but if the ash were heated to low red-heat it became inactive. The growth stimulant is therefore some relatively stable, organic substance, and it is compared with those materials known as auxetics or vitamines. Besides these matters of special interest, Dr. Allen's paper deals also, in a very interesting manner, with the general conditions of productivity of food substances in the sea, and is a good summary of our knowledge with regard to this important series of problems.

J. J.

SCIENCE AND TECHNOLOGY IN NEW ZEALAND.

THE quickening of interest in pure and technical science brought about by the war in our Colonies as well as in this country is shown by the action of the New Zealand Government in publishing a journal entitled the *New Zealand Journal of Science and Technology,* to appear quarterly under the general editorship of a group of representative scientific men of New Zealand. This is intended to include a number of the shorter and more popular articles on scientific subjects which are likely to interest the general public, and is supplementary to the more detailed and extended reports of the various scientific departments of the Government. In this way it is hoped to interest and instruct the public in scientific questions, and to cause the growth of a healthy public opinion on the need for the organisation and extension of industrial research in the community.

The first number of the new journal, containing sixty-five pages, covers a very wide range of topics of general interest, including short articles on various biological and geological subjects and several papers dealing with mining matters, while an interesting account is given by E. Best on the Maori system of measurement. Special articles are contributed on the history and geology of the Wakamarina valley and goldfield and of the geology of the Waikato valley. Of particular interest is the account by L. Birks of the utilisation of the waters of Lake Coleridge as a source of electric power for the city of Christchurch, sixty-three miles distant. This is the first comparatively large-scale attempt to utilise the important sources of water power in the New Zealand lakes and rivers. The hydro-electric installation at Lake Coleridge was formally opened in November, 1914, shortly after the outbreak of war, and has un continuously since March 1, 1915. In the first year of its operation about 2000 kilowatts of power were utilised, and this increased to 4000 in the course of the second year. Six thousand kilowatts are now provided, and to meet further extension another installation of 3000 kilowatts is in course of erection, but has been much delayed owing to the war. This enterprise has proved such a success that it is likely to stimulate the public to make further use in the near future of their great natural resources in water power for general industrial purposes. In another article E. Parry discusses the economics of electric-power distribution, and emphasises the importance and economy of a centralised plant for the distribution of electric power for the larger towns.

Altogether the new journal has made an excellent beginning, and is likely to prove a useful asset in interesting and educating the public in the importance of the application of scientific methods to the needs of a young community.

THE CARNEGIE INSTITUTION AND THE "HUMANITIES."

One section of the report of the president of the Carnegie Institution of Washington for the year ending October 31, 1917, which appears in the Year Book, No. 16, recently received, deals exhaustively with the relations of the institution and the public. The subjoined extracts from the report are of more than domestic interest.

It is often openly asserted and more often tacitly assumed that an endowed altruistic organisation acting under a State or a national charter may proceed without restrictions in the development of its work. Thus, in accordance with this view, the institution is frequently congratulated on its supposed freedom from governmental control and on its supposed immunity from social restraint. But this view is neither consonant with fact nor consistent with sound public policy. All such organisations are properly subject not only to the literal constraints of their charters, but also to the commonly more narrow, though unwritten, limitations imposed by contemporary opinion. The ideal to be sought by them in any case consists in a reciprocity of relations between the individual endowment on one hand and the vastly larger and more influential public on the other. This ideal, however, like most ideals, is rarely fully attainable. Hence, any new altruistic organisation is apt to find itself oscillating between two extreme dangers: one arising from action on the part of the organisation prejudicial to public interests; the other arising from public expectations impossible of attainment and therefore prejudicial to the organisation.

Happily for the institution, neither of these extreme dangers has been seriously encountered. Its evolution has proceeded without surpassing charter limitations and without permanent hindrance from an aggregate of expectations certainly quite unparalleled in the history of research establishments. But while thus far it has been practicable to steer clear of the rocks and the shoals towards which enthusiastic friends even of the institution would have it head, and to demonstrate the inappropriateness, the futility, or the impossibility of a large number of recurring suggestions for application of the institution's income, there remains a multitude of subjects and objects of omnipresent importunity for which the institution has furnished and apparently can furnish only general disappointment. There are two classes of them presenting widely different aspects, which appear worthy of special mention at the present unusual epoch in the intellectual development of mankind. These two classes find expression respectively in the perennial pleas of humanists for a larger share of the institution's income and in the more persistently perennial pleas of aberrant types of mind for special privileges not asked for, and not expected by, the normal devotees to learning.

Claims of Humanists.

Whenever and wherever the rules of arithmetic are ignored, then and there will develop vagaries, misunderstandings, and errors of fact that only the slow processes of time can correct. Hence it was not simply natural but also necessary that in the evolution of the institution something like conflict surpassing the bounds of generous rivalry should arise between claimants whose aggregate of demands for application of income has constantly exceeded the endowment from which income is derived. It might likewise have been predicted with certainty that the largest share of the resulting disapprobation visited upon the institution should come from the province of the humanists, not because they possess any property of superiority or inferiority, or any other singularity, but, first, for the reason that they are more numerous in the aggregate than the devotees of all other provinces combined; and, secondly, for the less obvious but more important reason that the subjects and objects of their province are more numerous, more varied, more complex, and in general less well defined than the subjects and objects of any other province.

Concerning all these matters humanistic which have agitated academic circles especially for centuries, the administrative office of the institution is naturally called upon to share in an extensive correspondence. Some of this is edifying, most of it is instructive, but a large, if not the greater, part of it appears to have been relatively fruitless in comparison with the time and the effort consumed.

An appeal to that correspondence shows, in the first place, that there is no consensus of opinion amongst professed humanists as to what the humanities are. It is well known, of course, by those who have taken the trouble to reflect a little, that the words "humanistic" and "humanist" are highly technical terms, more so, for example, than the term "moment of inertia," the full mechanical and historical significance of which can be understood only by consulting Euler's "Theoria Motus Corporum Solidorum." Technically, the humanist is not necessarily humane, though fortunately for the rest of us he generally possesses this admirable quality; he needs only to be human.

But these finer shades of verbal distinction which, with more or less elaboration, have come down to plague us from the days of the illustrious Alcuin and Erasmus, but with no such intent on their part, are less disconcerting than other revelations supplied by this expert testimony. It shows, in the second place, the surprising fact that some few humanists would restrict this field of endeavour to literature alone. From this *minimum minimorum* of content the estimates of our esteemed correspondents vary with many fluctuations all the way up to a *maximum maximorum* which would embrace all that is included in the comprehensive definition of anthropology to be found in the Standard Dictionary.

Thus some eminent authorities would exclude from the humanities all the ancient classics even, except their literatures. To such devotees philology, literary or comparative, has no interest; while archæology, classical or cosmopolitan, is of no more concern to them than comparative anatomy, which latter, by the way, is held in certain quarters to comprise the whole of anthropology. Equally confident groups of enthusiasts, on the other hand, animated by visions held essential to prevent our race from perishing, would, each in its own way, have the institution set up boundaries to knowledge within which the humanities, as always hitherto, would play the dominant part, but the appropriateness of fixation of which would be immediately disputed by other groups. There would be, in fact, only one point of agreement between them, namely, that the institution's income is none too large to meet the needs of any group.

It should be observed in passing, however, in fairness to our friends the humanists, that they are not alone in their regressive efforts to establish metes and bounds for advancing knowledge. Contemporary men of science have likewise pursued the same *ignis fatuus* with similarly futile results, as is best shown by the arbitrary and often thought-tight compartments into which science is divided by academies and royal societies. A sense of humour leads us to conclude that these likenesses between groups and assemblages thereof, still more or less hostile at times to one another, serve well to prove that the individuals concerned are human, if not humanistic, and that they all belong to the same genus, if not to the same species.

There is included also in the extensive correspondence on which this section is mainly based a special contribution of letters furnished mostly by university presidents and professors and by men of letters selected with the view of excluding all those who might be suspected of any non-humanistic predilections. These letters were received as replies to a communication issued first during the year 1910, and occasionally since then, soliciting counsel from those well qualified to assist the institution in determining how it may best promote research and progress in the humanities and how it may be relieved of the charge of unfairness towards them in the allotment of its income. The essential paragraphs in this communication are the following:—

"Amongst other suggestions arising naturally in this inquiry is that of the desirability of something like a working definition of the term 'humanities.' To the question, What are the humanities? one finds a variety of answers, some of which seem much narrower than desirable.

"In order to get additional information on this subject, and in order to make this part of the inquiry as concrete and definite as possible, I am sending copies of the enclosed list of publications to a number of friends, requesting them to mark those entries of the list which they, as individuals, would consider works falling properly in the fields of the humanities. I shall esteem it a great favour, therefore, if you will kindly examine this list, indicating by some sort of check-mark what works, if any, may be rightly so classed, and then mail the same in the enclosed stamped envelope. It will be of service also to indicate to me, if you care to do so, the lines of distinction which may be drawn between the humanistic sciences and the physical sciences. I am sure you will agree with me that it will be a decided aid to all of us to secure something like common definitions for these boundaries of knowledge."

About thirty distinguished authors have participated in this symposium; and their frank and generous expressions of opinion would be well worthy of publication if they had not been assured that their responses would not be used for such a purpose. It is believed that no confidence will be violated in stating the two following statistical facts, which not only agree with one another, but strongly confirm also the inductions referred to above, drawn from the more miscellaneous correspondence of the institution:—

(1) The definitions of the term "humanities" vary from the exclusiveness of literature alone to the inclusiveness of the more recent definitions of anthropology, with a noteworthy tendency towards inclusiveness rather than the reverse.

(2) To the concrete question, What works, if any, already published by the institution fall in the humanities? the answers vary from two to thirty-three, the number of publications up to 1910 being 146.

In the meantime, while waiting for a diminution in the diversity of opinion, it appears to be the duty of the institution to proceed, as it has sought to proceed hitherto, in a spirit of sympathy and equity based on merit towards all domains of knowledge, with a full appreciation of the necessary limitations of any single organisation, and with a respectful but untrammelled regard for the views, the sentiments, and the suffrages of our contemporaries.

Aberrant Types of Mind.

If words and phrases drawn out of the past may obscure thought and supplant reason in the domains of the less highly developed sciences, like the humanities, for example, they are by no means free from difficulties when used as media for the communication of ideas in the domains of the more highly developed sciences. The differences between the ambiguities and the obscurities of the two domains are mainly in degree rather than in kind. It is a truism, of course, that in general it is much easier to discover errors and to improve uncertain verbal expression in the definite than in the indefinite sciences. Erroneous statements and interpretations of fact may be often corrected by the facts themselves or by means of a knowledge of their relations to underlying principles. Precision and correctness of language are also greatly increased in any department of learning when it becomes susceptible to the economy of thought and of expression characteristic of the mathematico-physical sciences. The perfection of these latter is, indeed, so great that novices working in them are often carried safely over hazardous ground to sound conclusions without adequate apprehension of the principles involved and with only erroneous verbal terms at command to designate the facts and the phenomena considered.

Nevertheless, it must be admitted that the terminology of what commonly passes for science, as well as the terminology used frequently even by eminent men of science, is sadly in need of reformation in the interests of clear thinking, and hence of unequivocal popular and technical exposition. To realise the vagueness and the inappropriateness in much of the current use of this terminology, one needs only to examine the voluminous literature available in almost any subject called scientific. It is so much easier to appear to write well, or even brilliantly, than it is to think clearly, that facile expression is often mistaken for sound thought. Thus, to illustrate, while in physics the terms force, power, and energy have acquired technical meanings entirely distinct and free from ambiguity, they are commonly used as synonyms, and quite too commonly to designate properties, sentiments, and influences to which their application is meaningless. The "forces," the "powers," and, more recently, the "energies" of "Nature" are frequently appealed to in popular literature; and a familiar bathos consists in equipping them solemnly with the now vanishing stable furniture "for the benefit of mankind." Science is disfigured and hindered also by much inherited antithetical terminology for which reasons once existent have now disappeared or are disappearing. Instances are found in such terms as metaphysics, natural history, and natural science, the two latter of which appear to have come down to us without sensible modification, except for a vast increase in content, since the days of Pliny the Elder. The diversification and the resulting multiplication of meanings of the terms of science are everywhere becoming increasingly noticeable and confusing. One of the most recent manifestations is seen in the phrase "scientific and industrial research," which probably means about the same thing as the equally uncertain phrase "pure and applied science"; while both phrases have been turned to account in setting up invidious distinctions inimical to the progress of all concerned.

This looseness in the use of terminology inherited from our predominantly literary predecessors and the prevailing absence of any exacting standards of excellence in exposition make it easy for that large class here designated as aberrant types to take an unduly prominent part in the evolution of any establishment founded for the promotion of "research and discovery and the application of knowledge for the improvement of mankind." These types are numerous, and each of them presents all gradations ranging from harmless mental incapacity up to aggressive pseudo-science, which latter often wins popular approval and thus eclipses the demonstrations of saner counsels. The representatives of these types are variously distinguished in common parlance as cranks, quacks, aliens, charlatans, mountebanks, etc. Some of the most persistent types are known as arc-trisectors, circle-squarers, and perpetual-motion men and women. They are not of recent development; they are co-extensive with our race; but they have been little studied except in the cases of extreme divergence from the normal.

It ought to be well known, but evidently is not, that the institution has had to deal with, and must continue to be harassed by, great numbers of these aberrant types. The happy phrase of the founder concerning the "exceptional man" has worked out very unhappily both for them and for the institution, since it has only inevitable disappointment to meet their importunate demands, while they in turn have only inevitable animadversion to visit finally upon the institution. Deluded enthusiasts and designing charlatans entertain alike the illusion that here at last is an establishment that will enable them to realise their wildest dreams of fame and fortune. But in the end the hopes of these people are either rudely shocked or wrecked, not because the institution would disturb them in their fancies, but because they compel the institution to decline to approve their theories and to subsidise their projects. Two illustrations drawn from the older and hence more impersonal sciences may suffice to indicate the nature of the daily experience here in question :—

(1) A teacher of youth in a public school desires assistance in securing letters-patent for a new proof of the Pythagorean theorem. And why not, since we read every day in the public Press and in the debates of legislative bodies of "principles" being patented?

(2) Quite recently it has been "discovered" that the air and the æther contain "free energy." If this is so, if energy, like urbanity, is free, why should it not be rendered available at the expense of the institution for the improvement of mankind?

Study and reflection concerning these aberrant types and an intimate association with them beginning thirty years before the foundation of the institution all point to the conclusion that responsibility for their undue prominence must be attributed in large degree and in the last analysis to a prevalent inadequate development of critical capacity even amongst the best educated classes of contemporary life. Many representatives of these latter regard the eccentric individual as thereby worthy of special attention. He is often referred to as a sprite or as a male witch, but commonly, of course, under the more familiar designations of our day as "a genius" or as "a wizard." Thus it is quite easy for obvious charlatans and ignoramuses, as well as for those in pursuit of Sisyphean paralogisms and anachronisms, to secure letters of introduction and commendation to the institution from distinguished people, who pass the applicants along on the theory apparently that no harm can result from an effort to assist in the laudable work of extending learning. It is assumed that a research establishment must have effective facilities for utilising the necromantic capacities attributed to those in particular to whom the terms "genius" and "wizard" are by common consent applied. Such introductions and commendations are generally held to be equivalent to approvals which may not be lightly set aside. The suggestion of tests of the pretensions and of checks on the deductions of these applicants is repulsive to them. What they desire is not diagnosis, but endorsement.

In dealing with these aberrant types there are encountered certain other fallacies of a more specious, and hence of a more troublesome, character. They arise out of the prevailing innocence of, if not contempt for, the doctrine of probabilities. The simplest of these fallacies is seen in the common belief that one mind is as likely as another to make discoveries and advances in the realms of the unknown. Thus it is assumed that research establishments should maintain experts, or corps of them, for the purpose of promoting the efforts of tyros, amateurs, and dilettanti, or, in other words, perform the functions of elementary schools. A subtler fallacy is expressed in the more common belief that a research organisation should occupy itself chiefly in soliciting and in examining miscellaneous suggestions. It is held that if these are received in large numbers and if they are read long enough and hard enough, the possibilities of knowledge will be completely compassed. The worst of all these fallacies is found in the not unpopular notion that if experts could be set at work under the direction of inexperts great progress could be achieved. This is the fallacy so often used to justify placing technical work under the administration of politicians and promoters rather than under the charge of competent men. It finds frequent expression also in suggestions to the institution that its corps of investigators might avoid the dangers of "respectable mediocrity" by yielding to the requests of the less conservative and more brilliant advocates of advancing knowledge.

But what, it may be asked, are the characteristics which differentiate these pseudo-men of science from normal investigators? They are well defined and not numerous. The pseudo-man of science is in general excessively egoistic, secretive, averse to criticism, and almost always unaware of the works of his predecessors and contemporaries in the same field. He displays little of that caution which is born of adequate knowledge. He is lacking especially in capacity to discover and to correct his own mistakes. He is for ever challenging others to find errors in his work. He has an overweening confidence often in formal logic, but is unable to see that this useful device may play tricks by bringing him, for example, simultaneously to right and to wrong conclusions by reason of wrong premises. His worst defect is manifested in asking for, and in expecting to get, more lenient consideration in the forum of demonstration than that accorded to his more modest but more effective competitors.

How inadequate are the hasty popular estimates of these exceptional individuals is sufficiently witnessed in the extensive experience of the institution. In the brief interval of its existence it has had to deal with about 12,000 of them. Many of these have been commended to the institution in terms well calculated to set aside the laws of biologic continuity and thus to elevate the aspirants abruptly from irreproachable respectability to questionable fame. To some of them have been attributed qualities worthy of the mythological characteristics conceived by the unrestrained imaginations of men in pre-scientific times. Not a few of them have proved to be obvious fakers, schemers, or incompetents masquerading in the name of learning with the confident expectation that the institution would endorse, finance, or otherwise promote their objects under the guise of research. But, as might have been predicted, the history of all this varied experience is a history of futility clouded here and there by manifestations of the baser traits of mankind and lighted up only occasionally by flashes of wit, wisdom, or humour in the prevailing pathologic cast.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the last meeting of the council of the University a communication was received from Dr. R. S. Heath stating that owing to ill-health he desired to retire from his appointments as vice-principal, professor of mathematics, and registrar. Dr. Heath was appointed to his chair in Mason College in May, 1884—thirty-four years ago. Appointed chairman of the College Academic Board in 1889 and principal of the college in 1890, he was included in the University charter as the first vice-principal, undertaking in addition the duties of registrar. As a member of council and senate he has rendered splendid service to the University, and ably represented it on many educational bodies.

Dr. Stacey Wilson is resigning his lectureship in medicine to dental students in September next, after upwards of twenty-six years' service.

Dr. Mary Clarke is resigning her post as lecturer in hygiene to students in the Training College for Women owing to a great increase in hospital work.

Upon the nomination of the Dean of the medical faculty, the council has appointed Dr. Thomas Wilson Sub-Dean of the faculty.

Miss B. M. Bristol and Miss N. Carter have been appointed honorary demonstrators in botany for the current term.

THE Dr. Edith Pechey Phipson post-graduate scholarship of the London (Royal Free Hospital) School of Medicine for Women is to be awarded in June. It is of the yearly value of 40*l*. for a period not exceeding three years, and is open to all medical women, preferably coming from India or going to work there, for assistance in post-graduate study. Applications must be received by May 31 by the Warden and Secretary of the School, 8 Hunter Street, Brunswick Square, W.C.1.

IN connection with the Department of Applied Statistics and Eugenics of University College, London, the Crewdson Benington studentship in anthropometry and craniology (value 100*l*.) and a Francis Galton studentship in eugenics (value 130*l*.) are to be filled in July next. Candidates must be post-graduates, and have had training in mathematics, physical measurements, biology, and computing. Applications should be made to the Director of the Biometric and Galton Laboratories, University College, Gower Street, W.C.1.

THE report on educational reform adopted by the conference of the London Teachers' Association in November last has been issued in pamphlet form. It anticipates in some respects the chief provisions of the Education Bill introduced by Mr. Fisher in February last, which is now under consideration in Committee of the House of Commons. It is highly satisfactory to find so important a body of teachers in whole-hearted support of the measures of educational reform initiated and so convincingly advocated by Mr. Fisher, and it should have a highly beneficial influence in promoting the ultimate passage of the Bill. Where the aims of the conference go beyond the provisions of the Bill, which are, in effect, in the nature of a practical compromise of conflicting demands, and might well await the results of experience, it would be wise for the great body of teachers to give unwavering support to the measure as it stands, which, if it is to have any chance of success in the present Parliamentary session, will need all the help the friends of education can bring. There has grown up during these nearly four years of calamitous war a strong conviction that the salvation of the nation is to be found in the provision of the means of complete education for all classes of the people, especially with a view to the extended electorate and the grave responsibilities which it implies; that the children are the nation's greatest asset; and that for the comparatively large number of really capable children to be found in all strata of the nation, even the lowest, there should be brought into existence the fullest facilities for their adequate training, alike physical, intellectual, and moral, so as to fit them for the duties of life and for the highest service, according to their capacities and opportunities. The conference demands the most complete university education and training for all classes of teachers in both subject and method, and an unlimited scope for gifts and experience, with adequate reward during service and due provision on retirement, and insists that in all grades of the inspectorate there shall be guarantees of high practical skill as teachers and full knowledge of the best educational theory. Only on such terms can the nation be assured of a corps of efficient public servants in the most important of its many various spheres of national service.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 25.—Sir J. J. Thomson, president, in the chair.—Sir Charles **Parsons**: Bakerian lecture: Experiments on the production of diamond. The paper alludes to some of the results of experiments described in papers by the author to the Royal Society in 1888 and 1907, particularly to those on the decomposition by heat of carbon compounds under high pressure, and on the effect of applying pressure to iron during rapid cooling. A description is given of experiments designed to melt carbon under pressures up to 15,000 atmospheres by resistance heating and by the sudden compression of acetylene oxygen flame, also by the firing of high-velocity steel bullets through incandescent carbon into a cavity in a block of steel. Allusion is made to experiments on chemical reactions under high pressure and their results. The pressures occurring in rapidly cooled ingots of iron, and experiments bearing upon this question, are discussed. Experiments at atmospheric pressure and also *in vacuo* are described. The main conclusions arrived at are:—That graphite cannot be converted into diamond by heat and pressure alone within the limits reached in the experiments; that there is no distinct evidence that any of the chemical reactions under pressure have yielded diamond; that the only undoubted source of diamond is from iron previously heated to high temperature and then cooled; and that diamond is produced, not by bulk pressure, as previously supposed, but by the action of the gases occluded in the metal and condensed into the centre on quick cooling.

Geological Society, April 17.—Mr. G. W. Lamplugh, president, in the chair.—A. E. **Trueman**: The evolution of the Liparoceratidæ. The Ammonites considered include several subparallel series, of which four genera were indicated by Mr. S. S. Buckman in "Yorkshire Type Ammonites." The details of ontogeny and the sutures have been employed in constructing tables showing both the biological and the stratigraphical relations of the various species; a revision of the existing classification is proposed. The early members of each series are similar "capricorn" forms with slender whorls and stout ribs. In somewhat later examples the outer whorl is swollen and has paired tubercles. From this stage the tendency is to shorten the period with slender capricorn whorls by accelerating the development of bituberculation and prolonging the period of pre-costate globose whorls. The following genera may be recognised; each includes Ammonites of the three types mentioned above:—(1) An earlier group, with tubercles paired in the involute stages; Radstock (Somerset) is the only British locality where these Ammonites have been found. (2) A later group, with unpaired tubercles in the involute stage. These genera are most readily distinguished by sutural characters, namely, the relative depths of the external lobe (EL) and the first lateral lobe (IL), and by the width of the external saddle (ES). (*a*) With narrow ES (not reaching to the outer tubercles). (*b*) With wide ES, reaching to the outer tubercles. These Ammonites generally occur in the upper part of the Lower Lias, where it has been usual to recognise a *capricornus* zone overlying a *striatus* zone. There are several horizons with capricorn Ammonites of different series, and several with the involute forms evolved from them. In no locality examined is the complete sequence shown. The absence of some groups is due to the original distribution of the Ammonites; in other cases it is due to non-sequences. Two groups of Lias Ammonites are recognised, namely: (i) those which were evolved directly from a globose ancestor, and (ii) those which passed through an intermediate broad-ventered (cadicone) stage.

Royal Microscopical Society, April 17.—Mr. J. E. Barnard, president, in the chair.—J. M. **Brown**: *Pyxidicula invisitata*, a Rhizopod new to Britain, and *Hedriocystis spinifera*, a new Helizoon. The first-named appears to be widely distributed in Britain, but has not apparently been referred to by any author since first described by Averintzeff. The second species is related to *H. reticulata*, Penard, but is smaller, has no pedical, and is provided with spines at the angles of the facets of the capsule.—E. **Atkinson**: Hypo-eutectoid steel. Details of a systematic research (R.288) were given, the investigation being conducted to find the cause of failure in a hypo-eutectoid steel of the middle carbon range. In turn each of the following was dealt with:—(1) Mechanical test by laboratory adaptation of the Brinell test; (2) evolution of H_2S for printing; (3) tensile testing; (4) chemical composition; (5) computation of pearlite, MnS, and ferrite to be expected under the microscope; (6) a complete series of photomicrographs showing enclosures of MnS, pearlite, sorbitic pearlite, banded ferrite or "ghost lines." Structural deformation and types of micro-structures were rarely met with. Then followed several illustrations of normal steels with varying percentages of carbon, commencing with an almost pearlite-free iron. The paper also embraced the preparation of specimens, development of structures by "etching," and the lens system used in the author's laboratory for illuminating the specimens. A brief, though very thorough, description of the manufacture of hypo-eutectoid steel concluded the paper.—E. J. **Sheppard**: Two valuable methods of staining in bulk and counter-staining. The author described a new method of staining in bulk with carmalum and counter-staining with light green, and a second method of staining in bulk with iron hæmatoxylin and counter-staining with erythrosine, both of which methods gave excellent results.

Linnean Society, April 18.—Sir David Prain, president, in the chair.—Prof. J. P. **Hill**: An expedition to Brazil in 1913. The expedition was supported by grants from the Government Grant Committee and Council of the Royal Society, and the trustees of the Percy Sladen Fund. The primary object was to obtain material for studying the development of certain American marsupials, the most familiar being the American opossum. When the expedition was organised, our knowledge of the development of Didelphys rested on the incomplete account given by Emil Selenka in 1886; the author's own observations on the Australian native cat, Dasyurus, differed essentially from Selenka's statements, and it was hoped to get the facts concerning them. Another point was to determine the development of those genera regarded on anatomical grounds as nearest the base of the Didelphyd series, namely, Marmosa and Peramys; these are small rat-like creatures, remarkable for the entire absence of the pouch so characteristic of the other members of the order. Summing up the results, the expedition may be regarded as successful, though all its objects were not attained. Besides the material for anatomical investigation, a small collection of rodents was brought back, about eight genera of Muridæ, and an interesting series of frogs, about twenty-two species, two being new.

MANCHESTER.

Literary and Philosophical Society, April 23.—Mr. W. Thomson, president, in the chair.—Dr. E. **Newbery** and H. **Lupton**: Radio-activity and the coloration of minerals. A number of mineral specimens were examined as to their behaviour (*a*) on heating, (*b*) on treatment with radium or cathode rays before or after heating, and (*c*) on heating after treatment (*b*). Several brilliant colour effects were obtained, among which may be mentioned the complete restoration of the original colour to green fluorite, smoky quartz, zircon, topaz, etc., which had been decolorised by heat, the production of a fine deep blue colour in a colourless fluorite from Matlock by radium, an intense purple in colourless fluorite from the Pyrenees by cathode rays, and an indigo blue in transparent barytes by radium. A bright green thermo-luminescence was imparted to all the fluorites used, and their original violet thermo-luminescence was also restored if that had been destroyed by previous heating. A Spanish phosphorite gave a brilliant yellow thermo-luminescence which was restored with increased strength by radium or cathode rays. It was concluded that many minerals owe their colour and thermo-luminescence to the presence of radio-active matter either in the water from which they have been deposited or in the surrounding rock. Traces of certain inorganic impurities are acted upon by α, β, or γ rays and dissociated, the size or density of the resulting particles determining the colour produced. On heating, the dissociated atoms recombine with evolution of light and loss of colour to the mineral.

DUBLIN.

Royal Dublin Society, March 26.—Dr. G. H. Pethybridge in the chair.—R. G. **Allen**: The electrical resistance of porcelain at different temperatures. The results of testing the insulation resistance of eight samples of various forms of porcelain were given for temperatures ranging from about 20° C. to nearly 300° C., and these results showed that for each the simple relation between insulation resistance and absolute temperature previously given by Rasch and Hinrichsen was confirmed. A means of discovering the identity of a sample of unknown porcelain was also pointed out.—J. **Doyle**: Observations on the morphology of *Larix leptolepis* (two papers). The first part deals with the development of the double pollen grains. Owing to the obliquity of the first division spindle, even through a right angle, the first cell cut off may be one-third, or even one-half, the original cell. If one-third is cut off, this part may divide a little irregularly; the larger part, however, proceeds normally, as if the first division had been a small prothallial cell. If the first division is equal, each half gives rise to one prothallial cell, tube cell, and body cell. In this case the prothallial cell may be cut off at any side, but only one (and always one) is cut off. The whole process is similar to that in Picea. The mature grain has very distinct walls bounding the prothallial cells, and distinct vestiges of a wall surrounding the generative nucleus. Evidence is also adduced against the idea that the cavities in the stamen apex of the Abietineæ are abortive sporangia. In the second part of the paper the development of the female gametophyte is followed out, and, as was to be expected, it agrees accurately with the typical Abietinean plan, including the typical pro-embryo. One marked peculiarity is this: pollen is received by the ovule by a peculiar micropylar development which includes a median constriction and a mass of stigmatic hairs at the opening, exactly as in Pseudotsuga. The pollen in Larix can germinate only on the nucellus, differing in this respect from Pseudotsuga. This is not common, as only one ovule in four has a nucellar grain, and, with few exceptions, one such grain. How the grain reaches the nucellus was not determined. None were so found until June. The main features of the female gametophyte are very similar to Pseudotsuga. In a summary of details it is shown that Pseudotsuga and Larix are very closely allied, though separated in the ordinary classifications. This, however, confirms conclusions already arrived at by Jeffrey and Penhallow from anatomical data only.

April 23.—Dr. G. H. Pethybridge in the chair.—R. G. **Allen**: The insulating properties of erinoid. Results of tests were given for erinoid, an insulator of comparatively recent origin, and also for vulcanised fibre, which was employed for purposes of comparison and tested under the same conditions as the former material. The tests comprised the determination of certain physical properties of erinoid, its absorption and retention of water, the electrical resistance of machined and unmachined samples at different temperatures, and the effects of altering the thickness of the samples, changing the value of the applied voltage, and using different electrodes. It was found that for both erinoid and fibre a simple relation between resistance and temperature obtained; that erinoid, but not fibre, was free from dielectric absorption, and machined erinoid was practically independent of the applied voltage. As an insulator erinoid was found to be more stable than, and generally superior to, vulcanised fibre.—Sir John **Moore**: Solar haloes seen at Greystones, Co. Wicklow, September 22, 1879, and in Texas and Ohio, U.S.A., October 3, 1917. This was a short communication on a remarkable series of solar haloes which were observed at Houston, Texas, U.S.A., in the forenoon of October 3, 1917. Some hours later a modified form of the same phenomenon appeared at Gallia, Ohio, about 1000 miles (as the crow flies) to the north-east of Houston. An illustrated description of these unusual haloes was published in the *Monthly Weather Review*, Washington, October, 1917. Apart from the intrinsic beauty of the American display, much interest attached to it from the fact that a precisely similar phenomenon had been witnessed by the late Sir Robert Ball in the forenoon of September 22, 1879, at Greystones, Co. Wicklow.—Dr. H. H. **Dixon**: Mahogany and the recognition of some of the different kinds by their microscopic characteristics. This paper gives an account of the microscopic structure of some forty different woods usually marketed as mahogany, and contains a key by means of which these woods may be recognised by their microscopic characteristics. The structure of the woods described is illustrated by photomicrographs.

Royal Irish Academy, April 8.—The Most Rev. Dr. Bernard, Archbishop of Dublin, president, in the chair.—J. A. **McClelland** and P. J. **Nolan**: The nature of the ions produced by bubbling air through liquids. Previous papers by the authors and by J. J. Nolan have shown the existence of groups of ions of widely different mobilities in air that has been used in the spraying of water or that has been bubbled through water or mercury. The present paper is an extension of this work, and deals mainly with the results of bubbling air through alcohol. The existence of fourteen groups of ions is established, their mobilities ranging from 1·1 cm. per sec. to 0·00015 cm. per sec. in a field of one volt per cm. The relative amounts of the different ions present depend on the pressure used to force the air through the liquid, and on the time that elapses between the bubbling and the measurement of the mobilities. The nature of these ions is discussed in the paper.

April 22.—The Most Rev. Dr. Bernard, Archbishop of Dublin, president, in the chair.—H. **Ryan**, J. **Algar**, and P. **O'Connell**: Syntheses of some new substantive dyes derived from benzidine-sulphone. The preparation of about fourteen dyes from tetrazotised benzidine-sulphone-disulphonic acid by "coupling" with phenols and amines is described; the influence of the adjunct on the colour is discussed, and the possibility of utilising these substances in medicine indicated.—H. **Ryan** and T. **Glover**: The nitro-derivatives of diphenylamine. The determination of the constitution and the properties of several nitro-derivatives of diphenylamine was undertaken in order to facilitate the study of the action of the oxy-acids of nitrogen on the base. The authors also describe some new substances which they obtained by the action of nitric and nitrous acids on nitro-diphenylamines.—H. **Ryan** and Phyllis **Ryan**: The action of nitric acid and nitrous acid on diphenylamine. Part i.—H. **Ryan** and J. J. **Drumm**: The nitro-derivatives of phenyl-2-naphthylamine.

Paris.

Academy of Sciences, April 22.—M. P. Painlevé in the chair.—J. **Boussinesq**: Partial differential equations for states of sandy masses capable of flow in the neighbourhood of the Rankine-Levy solution.—L. **Lecornu**: The sign of rotations. In mechanics a rotation is regarded as positive when it is effected from left to right of the observer; astronomers adopt the opposite convention. The author discusses adversely the proposal to reverse the convention in mechanics and to take the same positive sense of rotation as in astronomy.—P. **Sabatier** and G. **Gaudion**: The crotonisation of acetaldehyde, formation of butanol and hexanol starting with ethanol. By the use of copper at 300° C. and uranyl oxide at 360° C. as catalysers, ethyl alcohol can be converted at one operation into crotonic aldehyde, the copper giving hydrogen and aldehyde, and the latter being converted into crotonaldehyde by the oxide of uranium. Better yields are obtained by starting with paraldehyde, the product being crotonaldehyde hexadienal and octatrienal, separable by fractional distillation. The aldehydes, by slow hydrogenation over nickel at 170° to 180° C., can be easily converted into the corresponding saturated alcohols, normal butyl alcohol and normal hexyl alcohol.—Ch. **Depéret**: An attempt at a general chronological co-ordination of Quaternary time.—M. L. Favé was elected a member of the section of geography and navigation in succession to the late Gen. Bassot.—A. **Véronnet**: Contraction and evolution of the sun.—F. **Roux**: The gold minerals of the Ivory Coast. Analyses of some specimens collected by the author at Kokumbo. The metallic portion of a quartz, without visible gold, gave bismuth 48 per cent., tellurium 37 per cent., gold 8·36 per cent. Two metallic specimens, extracted from the mineral from Poressou and containing 76·78 per cent. and 93·04 per cent. of gold, also contained tellurium and bismuth.—F. **La Marca**: A new hybrid produced by grafting.—A. **Guilliermond**: The nature and signification of the chondriome.—J. **Amar**: Physiological prothesis of the foot.—L. **Lumière**: A phenomenon of singular appearance relating to the persistence of luminous impressions.

BOOKS RECEIVED.

Organic Compounds of Arsenic and Antimony. By Prof. G. T. Morgan. (Monographs on Industrial Chemistry.) Pp. xx+376. (London: Longmans and Co.) 16*s*. net.

Edible Oils and Fats. By C. A. Mitchell. Pp. xii+159. (Monographs on Industrial Chemistry.) (London: Longmans and Co.) 6*s*. 6*d*. net.

Soil Physics and Management. By Prof. J. G. Mosier and A. F. Gustafson. Pp. xiii+442. (Philadelphia and London: J. B. Lippincott Co.) 8*s*. 6*d*. net.

Veterinary Post-Mortem Technic. By Prof. W. J. Crocker. Pp. xiv+233. (Philadelphia and London: J. B. Lippincott Co.) 16*s*. net.

A Not Impossible Religion. By S. P. Thompson. Pp. xv+335. (London: J. Lane.) 6*s*. net.

Mind and the Nation. By J. H. Parsons. Pp. 154. (London: John Bale, Ltd.) 7*s*. 6*d*. net.

The Photographic Industry of Great Britain, 1918. (London: British Photographic Manufacturers' Association, Ltd.)

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Thirty-fourth annual issue. Pp. vii+334. (London: C. Griffin and Co., Ltd.) 9*s*.

Tropic Days. By E. J. Banfield. Pp. 313. (London: T. Fisher Unwin, Ltd.) 16*s*. net.

DIARY OF SOCIETIES.

THURSDAY, May 9.

Royal Society, at 4.30.—Contribution to the Theory of Attraction when the Force varies as any Power of the Distance: Major P. A. MacMahon and H. B. C. Darling.—Electromagnetic Integrals: Sir George Greenhill.—Intensity Relations in the Spectrum of Helium: Dr. T. R. Merton and Prof. J. W. Nicholson.—The Outline of a Theory of Magnetic Storms: Dr. S. Chapman.

Royal Institution, at 3.—The Folk Lore of Bells: Sir J. G. Frazer.

Royal Society of Arts, at 4.30.—The Freedom of the Sea: Sir F. T. Piggott.

Institution of Electrical Engineers, at 6.—*Discussion*: A British Electrical Proving House. Opener, C. Turnbull.

Optical Society (Imperial College of Science and Technology), at 7.—Note on Spherical Aberration: T. Y. Baker and Major L. N. G. Filon.

Mathematical Society, at 5.—The Continued Fractions connected with the Hypergeometric Equation: E. Lindsay Ince.

FRIDAY, May 10.

Royal Institution, at 5.30.—Human Nutrition: Prof. F. Gowland Hopkins.

Royal Astronomical Society, at 5.—Observations of Encke's Comet (1917*c*) made with the 28-in. Equatorial: Royal Observatory, Greenwich.—Absurd Conclusions Derived from Einstein's Gravitation Theory: L. Silberstein.—A New Variable Star in Auriga: A. Stanley Williams.—Baxendell's Observations of Variable Stars: H. H. Turner and Mary A. Blagg.—*Probable Papers*: The Measurement of Time to the Thousandth of a Second: R. A. Sampson.—The Variation of Latitude. Observations of Sirius and Procyon made with the 28-in. Refractor of the Royal Observatory, Greenwich: Sir F. W. Dyson.—The Period of Sirius: R. Jonckheere.—Twelfth Note on the Number of Faint Stars with Large Proper Motions: F. A. Bellamy.

Physical Society, at 5.—The Times of Sudden Commencement of Magnetic Storms: Dr. S. Chapman.—The Entropy of a Metal: Dr. H. S. Allen.—Tracing Rays through an Optical System: T. Smith.

MONDAY, May 13.

Royal Society of Arts, at 4.30.—Recent Developments in Leather Chemistry: Prof. H. R. Procter.

Royal Geographical Society, at 8.30.—The Achievements of France in Morocco: J. M. MacLeod.

Victoria Institute, at 4.30.—Terrestrial Magnetism: Dr. S. Chapman.

TUESDAY, May 14.

Royal Institution, at 3.—Field-Anthropologists: Prof. A. Keith.

Royal Society of Arts, at 4.30.—Recent Developments in Leather Chemistry: Prof. H. R. Procter.

Royal Statistical Society, at 5.15.—The Effect of Trade Fluctuations upon Profits: Dr. J. C. Stamp.

Illuminating Engineering Society, at 6.30.—*Discussion*: The Lighting, Heating, and Power Order (1918), and the Best Methods of Making Economies.

WEDNESDAY, May 15.

Royal Society of Arts, at 4.30.—The Timber Industry: Prof. Percy Groom.

Royal Meteorological Society, at 5.—Continentality and Temperature. II.: The Effect of Latitude on the Influence of Continentality on Temperature: C. E. P. Brooks.—Report on the Phenological Observations for 1917: J. E. Clark and H. B. Adames.

Geological Society, at 5.30.—The Geology of the Italian Front: Prof. E. J. Garwood.

Society of Glass Technology (Institute of Chemistry), at 2.30.—Furnace and Factory Operation for Automatic Glass-working Machinery: A. R. Hunter.—The Glass Industry after the War: W. F. J. Wood.

THURSDAY, May 16.

Royal Society, at 4.30.—*Probable Papers*: General Factors in Mental Measurements: J. C. M. Garnett.—The Absorption of X-Rays in Copper and Aluminium: C. M. Williams.—The Electrical Resolution and Broadening of Helium Lines: Dr. T. R. Merton.

Royal Institution, at 3.—The Prosecution and Punishment of Animals: Sir J. G. Frazer.

Royal Society of Arts, at 4.30.—The Freedom of the Sea: John Leyland.

Institution of Mining and Metallurgy, at 5.30.

FRIDAY, May 17.

Royal Institution, at 5.30.—The Story of a Grass: Dr. A. B. Rendle.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., Ltd.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: Phusis, London.
Telephone Number: Gerrard 8830.

THURSDAY, MAY 16, 1918.

AERODYNAMICS.

Resistance of Air. By Lt.-Col. R. de Villamil. Pp. x+192. (London: E. and F. N. Spon, Ltd., 1917.) Price 7s. 6d. net.

THE phenomenon of the resistance of a fluid to a body moving through it is complicated by the fact that it must depend not only on the density and elasticity of the fluid, but also on its viscous properties and on the nature of the relative motion. Mathematical investigations cannot at present lead to results that can be usefully applied, say, in aeroplane construction. Recourse must be had to experiment. During the past century many results have been obtained bearing on gunnery and navigation, whilst the great progress in aeronautics has been possible only because of the experiments of pioneers like Lilienthal, Langley, and Eiffel, and the systematic wind-tunnel researches at the National Physical Laboratory and elsewhere.

One of the most generally accepted conclusions is that fluid resistance is approximately proportional to the density, the square of rate of displacement, and the square of linear dimension. It is realised that this represents only a rough presentation of the actual state of affairs, and to take account of this fact it has been usual to consider the constant of proportionality "K" as a variable constant, depending on the nature of the fluid, the shape of the body, and the circumstances of the motion.

Col. de Villamil discusses the question in the light of the available experimental evidence, and in order to prevent the intrusion of irrelevant factors he very wisely restricts himself to a consideration of "the *law* of the resistance [in air] and the coefficients to be used for *flat*, square, or circular plates—with one or two small exceptions." There are three main questions: (1) Can the elasticity of the air be neglected? (2) Is there a "dimension effect"—*i.e.* does K vary if the only variable factor is size? (3) How does viscosity affect the resistance?

The author's conclusions can be summed up symbolically in the formula

$$R = K\rho(vl)^2(\nu/vl + c + bv/V),$$

where ρ, ν are the density and kinematic viscosity, v, l are the relative speed and a dimension, V is the "velocity of flow of the fluid into a *vacuum* at the pressure of the fluid experimented with," b, c are constants, and K is a coefficient of shape. He thus differs from Lanchester, who declares that the elasticity of the air can be neglected, and, though only formally, from Eiffel, and from Bairstow and others at the National Physical Laboratory, who assert the existence of a dimension effect.

Col. de Villamil bases much of his argument on dynamical similarity, and therefore devotes considerable—perhaps too much—space to an elucidation of the fundamental units of mechanics. His manner is vigorous and unorthodox, and his trenchant criticism of the professional mathematician is sometimes deserved and always enjoyable. Yet if the author desires to be read by "young people" he should pay less attention to polemics and more to notation. Not only is it bad pedagogy to present the innocent beginner with long and detailed criticisms of the false views held by others; but it is also very confusing when, after emerging from this thicket, he is brought up against a peculiar symbolism that suffers unexpected and unexplained changes.

With reference to his explanation of dynamical similarity the author says (p. 5): "I suppose I shall stand to be shot at; and I, equally, suppose I shall deserve it, since I am doing my best to 'give the show away.'" His first sentence on the principle as applied to air resistance runs as follows: "We first ask ourselves, Does the resistance due to viscosity cause change of momentum or not? We know perfectly well that it does: hence it is a 'Force.' We may consequently equate $\mu^x L^y V^z \rho^n = \text{Force} = MLT^{-2}$." Why is this array of symbols used to represent the resistance? Not a word of explanation is given. Why does the author violate his own dictum that symbols of dimension must not be regarded as algebraic symbols? Col. de Villamil need stand in no fear of the consequences of having "given the show away."

S. B.

MILITARY PSYCHOLOGY.

Il nostro Soldato. Saggi di Psicologia Militare. By Fr. Agostino Gemelli. Con prefazione del Padre Giovanni Semeria. Pp. xii+339. (Milano: Fratelli Treves, 1917.)

THIS work is a study of the psychology of the soldier, and embraces an analysis of the various psychological processes which come into play during the events of the war. The author, who has made the most of his opportunities during the periods of mobilisation, preparation for fighting, and actual warfare, has conducted a careful inquiry into the causes predisposing to cowardice as well as heroism. Every possible condition which influences the soldier's life has received attention at the writer's hands: the combatant's original bias of mind, his antecedent social life and habits, his training in camp and in the trenches, and all forms of discipline which teach him to consider himself one of a crowd united by spiritual bonds to each other for a common purpose.

There is a very interesting chapter on the psychic factors underlying courageous actions. Many soldiers, having passed safely through several dangers, at length develop the conviction that they have acquired an immunity to death. Some become persuaded that their vital parts will escape injury. Others are buoyed up by religious feelings and formulæ, while others again are sustained by superstition or the war-cries of their regiment. The feeling of danger when shared in common loses in gravity the greater the numbers engaged.

The author is interesting on the folk-lore of war and the signification of soldiers' songs. These he must admit are for the most part crude and childish, but possess the merit of dispelling sadness and relieving psychic tension, and tend to elevate the patriotic spirit. He quotes figures to prove that the infantry invariably bear the brunt of the battle and most truly are the representatives of their nation. When it comes to the final assault they are the principal factor in victory. Each nation has its own innate characteristics, and therefore each army its own methods of fighting, so that the slavish imitation of another nation's methods should be severely deprecated. The feats accomplished by the infantry are due to strict laws and to the correlation between the nation and the army; thus a people in possession of good infantry can achieve a durable success, and this can be established only on a love of national independence. Modern war, therefore, has accentuated and not diminished the importance of individuality in battle. The ultimate argument in war is not the cannon, but the man.

In the last few pages of the book the author gives a short though useful account of the effects of war upon the soldier's nervous system. His conclusion is that "war insanity" in the strict sense is either non-existent or extremely rare. War simply brings into evidence, in those individuals already predisposed, the classical symptoms of the various insanities with which we are familiar in civil life. This opinion is now universally accepted.

The author has devoted most study in this direction to the psychoneuroses caused by profound emotion—for example, "shell shock"—and emphasises their similarity with those found to occur after earthquakes and other disasters. Violent emotion tends to produce fear, which in a normal person may be unaccompanied by a morbid mental disturbance. In the predisposed, however, the violent emotion of fear determines symptoms of "shock," some elements of which are fixed for a longer or shorter time by auto-suggestion. The author does not accept the view that emotional and "shock" symptoms are separable.

The book is an extremely able study and well worthy of perusal. One cannot, however, avoid criticising the unusually close spacing. This, possibly, is due to measures of economy.

OZONE AS A HYGIENIC AGENT.

Ozone: Its Manufacture, Properties, and Uses. By Dr. A. Vosmaer. Pp. xii + 197. (London: Constable and Co., Ltd., 1916.) Price 10*s*. 6*d*. net.

In comparatively recent years the production of ozone, or rather of air containing a small percentage of ozone, on an industrial scale has reached a considerable degree of development, chiefly on account of its application to the sterilisation of drinking water. In a less degree ozonised air has been applied to the deodorisation of the air of public buildings, underground railways, etc. These technical developments are associated mainly with the names of the Siemens and Halske, Abraham-Marmier, Otto, and General Electric Companies.

As regards European works employing ozonised air for the purification of drinking water, Dr. Vosmaer gives a list of forty-nine installations, treating *in summo* nearly eighty-five million gallons of water per day of twenty-four hours. Of these the largest are at Paris, Petrograd, Nice, Villefranche, Lunéville, Lorient, Florence, Chartres, Saint-Servan, Laval, Compiègne, Constanza, and Wiesbaden.

Parts i. and ii. of the present work deal with the chemistry of ozone, the electrical discharge in gases, the different types of technical ozonisers and their output and efficiency. Part iii. is concerned with the uses of ozone, and part iv. contains a list of American patents bearing on ozone and a bibliography of papers and books.

Although it is undeniable that the book contains a good deal of useful information, and is written by an author practically familiar with the subject, it must be admitted that its scientific *niveau* is not high. Even when we come to the more technical part, where the author is obviously more at home, there is very little of that thorough quantitative information which is requisite for the scientific designer of plant. A number of diagrams, photographs of plant, and curves are given, but the treatment of the subject is distinctly sketchy and superficial, and does not convey the impression that the author possesses a real scientific knowledge of the chemical, electrical, and engineering principles relating to his subject. Viewed, however, as a semi-technical, semi-popular account of the manufacture and uses of ozone (which is, perhaps, all that the author intended it to be), the book is certainly interesting, and will, no doubt, be of use to readers unacquainted with the subject.

F. G. DONNAN.

OUR BOOKSHELF.

Cellulose: An Outline of the Chemistry of the Structural Elements of Plants with Reference to their Natural History and Industrial Uses. By Cross and Bevan. New impression, with Supplement. Pp. xviii + 348. (London: Longmans, Green, and Co., 1918.) Price 14*s*. net.

THIS well-known monograph by authors actively engaged in original investigation on many matters connected with the cellulose group is written in a manner stimulating to all workers in this field. The new impression is chiefly remarkable for a supplementary chapter of twenty pages, the greater portion of which is composed of the authors' critical review of researches published by others during the last two or three years. In addition there is a very interesting *résumé* of the authors' views on the standard of purity for "pure cellulose" and of their attempts to define a "normal cellulose." Whilst they regard cotton cellulose as the prototype of the group, it is affirmed, in contradistinction to the descriptions common in the older text-books of cellulose as a very stable substance, (1) that cellulose is constitutionally modified by any and every treatment with reagents, and (2) that profound changes affecting the reactivity of its individual groups are determined by treatments which are not marked by change of weight of the cellulose or by visible structural modifications.

It thus follows that surgical cotton-wool or chemical filter-papers, for example, which are often considered as "pure cellulose" and the criteria of purity adopted by various manufacturers, are selected on an empirical basis, and the authors, therefore, attempt to define the "normal standard." Their definition of this as cotton purified from its raw condition by such treatments as attack and remove its non-cellulosic components with the ascertained minimum of action upon the cellulose itself obviously raises difficulties in the verification of the so-called "standard" product. Their conclusions are most valuable as a stimulus to further research, and their statement that "every process of treating the vegetable fibres in the arts produces some constitutional change" shows how necessary is systematic research work organised on a co-operative basis for the continued well-being of all the textile and paper-making trades.

ROBERT H. PICKARD.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Compiled from official sources. Pp. viii + 334. (London: Charles Griffin and Co., Ltd., 1917.) Price 9*s*.

THE thirty-fourth annual issue of this useful work of reference provides a convenient record of the work done in science, literature, and art during the year 1916–17. Not only are the activities of the scientific societies chronicled, but an account is provided also of the researches carried out by the Meteorological Office, the National Physical Laboratory, the Royal Observatory at Greenwich, the Geological Survey, Kew Gardens, Rothamsted Experimental Station, and similar organisations of a national character.

The volume is very comprehensive in scope, but in the science sections we miss references to the Society of Glass Technology and to the Illuminating Engineering Society, both of which are active and important.

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.]*

Cotton-growing Statistics.

THE article on the above subject in NATURE of April 11 was welcome to me as directing attention to very important economic possibilities which lie behind the making of precise reports and reasoned forecasts concerning the state of all crops, by means of the Plant-Development-Curve method which I devised during my service in Egypt. With your permission, however, I would like to point out that the writer of the article was under a misapprehension in thinking that the recent Egyptian data he mentioned were adverse to this new method.

Although it is true that the paper cited from the *Agricultural Journal of Egypt* (vol. vii.) states that "the object of (1) was to study the life-history of the various types of cotton in the different parts of the country and to ascertain whether it was possible to estimate the yield of the crop several weeks before the cotton was ready for picking," yet the absence of further comment is obviously due merely to a certain looseness of structure in the paper in question, whereby a summary of results obtained under the stated purpose of this section "(1)" is given somewhat irrelevantly as follows on p. 52:—"The above observations seem to point to the fact that watering experiments on the cotton crop are most necessary; for if the flowering curve could be maintained (*sic*) during the whole of July instead of dropping considerably in the middle of the month, there should be a considerable increase in the yield of the crop."

Any decision as to the real result of this section of the paper in its declared object must therefore be taken from the data themselves, which are published in the form of plant-development curves.

So far as the prediction of bolling from flowering is concerned, with a seven-week interval between, the satisfactory nature of the results may be seen at a glance by those who care to consult the paper in question (although each curve represents the behaviour of only a single observation row of only fifty plants, instead of being the mean of at least five such rows of one hundred plants). In thus comparing the flowering and bolling curves, the reader should discard the first weekly ordinate in every bolling curve as there published, since the counting of the bolls was not started soon enough, and this ordinate, therefore, includes earlier bolls from the second, and even the third, antecedent week, which naturally spoils the similarity. On placing the curves in superposition with a seven-week shift, these new data (*e.g.* Fig. 9 and Fig. 11) then illustrate most satisfactorily the points which I have discussed in detail in "Analyses of Agricultural Yield" (Phil. Trans. Roy. Soc., B. 327, 333, 352), and specially demonstrated by Fig. 17 in part iii. of the "Analyses," such as the incidence of hot days, waterings, and boll-worm in affecting the shedding.

As regards the forecasting of the flowering itself by the growth-curve, the data under discussion have no significance. The daily fluctuation of flowering of cotton in Egypt is not predicted by main-stem growth measurements made later than June 1 (see Fig. 10 in my "Development and Properties of Raw Cotton"), owing to the four weeks' duration of this predetermination period, and to other causes which I discussed on p. 182 *et ante* of part iii. of the "Analyses." Since the growth-curves in vol. vii. of the *Agricultural Journal of Egypt* only began on May 28, they are effectively not for this purpose growth-curves at all. In any case, the growth should be measured daily, and not merely once a fortnight.

W. LAWRENCE BALLS.

St. James's Square, Manchester, April 16.

DR. BALLS'S comments on the short article on "Cotton-growing Statistics" in the issue of NATURE for April 11 opens up a wide and interesting feature in scientific research, viz. the value of observed data and their interpretation.

Vol. vii. of the *Agricultural Journal of Egypt* gives a series of plant-development curves plotted from observed data. This method is claimed by Dr. Balls as having been devised by himself, but surely botany has not had to wait so long for growth to be graphically represented. Flowering and fruiting of a considerable number of members of the vegetable kingdom can be almost definitely stated if the time of the appearance of the plant above ground be known. The question of watering and the consequent increase of the crop are points brought out by the report, but this is quite an elementary matter also. The reference to it on p. 52 is simply an enunciation of the obvious, and quite harmless.

Dr. Balls's statement that "the satisfactory nature of the results may be seen at a glance by those who care to consult the paper in question" can only be interpreted as meaning that one row of fifty plants has produced data of considerable value and quite satisfactory as compared with the data obtained by himself from five rows of one hundred plants. From the important deductions arrived at by Dr. Balls in the analysis referred to in his letter, the data must be of an unusually complete nature, and the daily observations of this large number of plants throughout a season would be extremely useful for other minds to work upon. If these data are accessible, then the Egyptian Agricultural Department has wasted time, money, and energy in repeating on a much smaller scale research work that has already been so effectively done on a much larger scale by one of its own employees. Presumably the Department had the previous complete data before it, and yet we find it undertaking the research work *de novo*. Stranger still, no mention is made of the previous work so completely carried out on such a large scale by the Department—so complete, in fact, that it forms a far surer basis for deductions than the series of data now found in vol. vii. of the *Agricultural Journal of Egypt*.

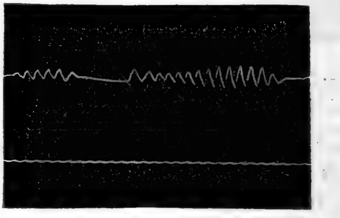
Dr. Balls is quite correct in saying that "as regards the forecasting of the flowering itself by the growth-curve, the data under discussion have no significance." The writer of the article came to the same conclusion. It would appear that data on growth prior to May 28 are essential, and this feature is treated very inadequately in the report. It may be added, however, that observations are given commencing at various dates from April 27 to May 23. In the case of No. 17 Ashmoun, the growth records date from April 27, but these give no indications of any peculiarity between April 27 and early in June; the growth-curve is practically a straight line for a mean of forty-two plants (see p. 30 of *Journal*). If all the plants gave similar results, it may explain why further tests were not made. In any case, it is quite evident that height, *per se*, had little influence on the flowering either as to its beginning or as to the attainment of its maximum flowering period. If this earlier period of growth is such as to be so distinctive as to afford a forecast that would be of such enormous value to a great industry, why has the Department of Agriculture totally ignored it? Dr. Balls clearly indicates that the experiment on a very large scale has been made, and he has used the data for his own conclusions, so the Department must have had these important results in their possession.

As regards "the prediction of bolling from flowering" and the seven-week interval between them, the curves do not give anything approaching a satisfactory agreement when superimposed, not even when treated so unscientifically as suggested. It must be acknowledged that the whole series of data lacks the element of a real appreciation of the practical deductions that might have been made from them, and the draughtsmanship is bad, as well as the reproduction of the curves. This, however, does not prevent the redrawing of the curves from the data on a large scale. If this is done they yield nothing but generalities, of even less value than a schoolboy's observations on the growth of a pea or a daisy. If the Egyptian Agricultural Department would give us the much more complete and exhaustive data already obtained by its own experts in previous research work, the cotton industry of the country would be considerably benefited by having a basis on which to build up its own conclusions.

THE WRITER OF THE ARTICLE.

The Duration of Resonance in the Internal Ear.

HELMHOLTZ's estimate, 9·5 free vibrations to reduce the intensity of a sound to one-tenth of its original value, was drawn from the effect of shakes or trills in music. It would have been better, instead of a reiteration of notes, to take the simple case of a single note ending staccato, as exemplified daily in speech. The reproduction here of a typical mouth-tracing, made with the kymograph, of the word *utter* in a phrase intoned rapidly at pitch 100, and timed by a 100 fork, shows that 9·5 vibrations would completely obliterate the mute or silence between the two utterances of voice. It would be impossible to distinguish *utter* from *udder*.



When speaking of the theory of resonance in the cochlea, Thomas Young had said (*Nat. Phil.*, 1807, i., p. 386):—"It is uncertain whether any fibres in the ear are thus sympathetically agitated in the process of hearing, but if there are any such vibrating fibres, their motions must necessarily be of short duration, otherwise there would be a perpetual ringing in our ears, and we should never be able to judge accurately of the termination of a sound." He returns to the subject on the next page. These remarks of Thomas Young appear to have been overlooked.

W. PERRETT.

University College, London, May 6.

Recovery of Speech through Excitement.

RECENTLY a soldier who had "lost" his speech through shell-shock was brought to me. I told him he was shamming, and that there would be trouble of an acute kind if he did not recover quickly. He was able to speak very well in a few days. I imagine that 99 per cent. of those who have lost their speech and then suddenly recovered it belong to the same category.

The case of the son of Crœsus quoted by Capt. Newton Friend in NATURE of May 9 is mythical. We learn to speak, and a man could no more speak at the first attempt than he could play the violin.

G. ARCHDALL REID.

Netherby, Victoria Road, S.,
Southsea, May 13.

A STUDY IN CONDITIONS OF HUMAN NURTURE.[1]

THE Carnegie United Kingdom Trust did the nation a good turn when it secured reports on the existing provision for promoting the physical welfare of mothers and young children in England and Wales, Scotland, and Ireland. The third volume, now before us, is by Dr. Leslie Mackenzie, and deals with Scotland. It is a very important human document, compiled with conspicuous scientific insight and unusual literary skill. It is not only well-planned, lucid, telling—it rises on appropriate occasions to a high level of art. We do not mean that there are purple passages, but something much subtler—that the author, in dealing with the intricacies of the human web of life and the often tragic clash of the human struggle for existence, has at strategic points attained to an impressive cadence and solemn dignity of diction which appeal to us as congruent with the urgency and seriousness of the problems discussed.

That artist and man of feeling should persist in a busy administrator is wonder enough, but our admiration grows as we realise the firm scientific grip and the fresh insight which the half-hundred chapters disclose. We should like to illustrate this by various examples.

(1) Dr. Mackenzie has shrewdly recognised the fundamental importance of the geographical factor. This note is struck in the two vivid maps—showing contours and distribution of population—which meet us at the threshold of the report, and it resounds through and through. The midland valley of Scotland contains one-fifth of the area, but about three-quarters of the population. A massive urbanisation, still very imperfectly integrated, has entailed a pressure of life which is hard on mothers and their children. The Highlands and islands, including more than half the area of Scotland, have only about one-tenth of the population, but the mitigation of the pressure of life is counterbalanced by the distances which often make the utilisation of medical and other welfare services difficult, and by such complications as the exceptional disproportion between local production of commodities and local demand, which explains the well-known seasonal exodus and other striking features.

(2) Following the Le Play method of regional survey, the author has obtained from numerous experts, as well as from his personal observations, a series of pictures of representative areas, such as a Highland parish, a mining village, an island in the Hebrides, an East Coast fishing village, a south-eastern agricultural area, a group of industrial villages, and so on. These special regional studies are of great value, and some of the general results, such as the apparent rarity of venereal diseases in the Highlands and islands, and fishing villages generally, have much biological as well as medical interest.

(3) The author's biological discipline has led him to attach much importance to intimate contact with his subject-matter—composed not of statistical units, but of flesh-and-blood, struggling organisms, his brothers and sisters, and children. This insight of sympathy, beyond scientific analysis and yet its needed complement, has led him to understand the people of Lewis and the like better than they understand themselves.

(4) In diagrammatic illustration of the author's mood and method we may refer to the so-called "black houses" of Lewis, still to be numbered in hundreds, if not in thousands (Figs. 1 and 2). They are without chimneys; the peat fire is kept burning day and night, and is, in spite of the smoke, the saviour of the household; the straw roof does not keep out the rain, and thus almost necessitates "box-beds"; there is often more than propinquity of the cows and their manure. The "black houses" are, of course, deplorable and deteriorative; but that is not their scientific description. The fact is that, in point after point, these "black houses" are like organisms built up under difficult conditions, meagrely perhaps, but with remarkable adaptiveness. The stones are from the moor; timber is from the sea; lime mortar is expensive; the roof must be moulted every year, and therefore the walls must be low; moreover, the gales are high. "At every point the house is adapted to its fundamental purposes," and what the doctrinaire student or the careless visitor dismisses as unworthy of savages, the product of laziness or perversity, turns out to be "a product of long labour and sacrifice," "a fundamental part of the only system of agriculture formerly found possible in this island of gneiss rock, clay, and peat moss." "It is part of the price that a people of

FIG. 1.—Hebrides. Typical "black house"—no chimney, no window.

[1] "Scottish Mothers and Children: Being a Report on the Physical Welfare of Mothers and Children." Vol. iii., "Scotland." By Dr. W. Leslie Mackenzie. Pp. xxviii+632; with 2 maps, 6 charts, and many illustrations. (East Port, Dunfermline: The Carnegie United Kingdom Trust, 1917.)

immense ability and high character have to pay for their civilisation."

The unsympathetic critic, who does not dwell with the people, as one must dwell with all sorts and conditions of living creatures if one is to understand them, does not discover that the peat smoke is tolerated and even encouraged day and night through all the winter in order that the straw may be saturated to form a manure which keeps the croft lands effective. The reasons for the so-called "cattle-housing" are similarly interpretable in terms of intelligible purpose. Not that the medical member of the Local Government Board for Scotland is advocating the encouragement of "black houses" and "cattle-housing." But he protests that we shall do well to pay to even the jetsam of the past the compliment of understanding it, or heaven help our future.

The geographer will be pleased by the author's appreciation of the basal importance of the map; the biologist will enjoy the recognition of the motor necessities and play necessities of the young child, and by the masterly way in which, amid an embarrassing multitude of details, the reader is never allowed to lose sight of the big underlying problem—the influence of nurture, environmental, nutritional, and functional, on the organism, whether adult and reproductive, or in process of early development. The author is neither optimist nor pessimist; he believes things can be bettered; he shows us what a multitude of salutary provisions are at present in operation; he indicates how development along the lines of education, research, and institutions may wipe away a reproach to our civilisation. Dr. Mackenzie has done great service to his day and generation in making his report, and he may take it as a sort of expression of his country's gratitude that the United Kingdom Trust should already have promised for Scotland, as well as for England, a national institute of maternal and child welfare.

FIG. 2.—Hebrides. South Uist, showing smoke issuing by doorway.

THE DEVELOPMENT OF TECHNICAL RESEARCH.

WITHIN the last year there has been an important movement in Germany having for its object the better application of scientific research to technical problems. It is well known that the same question has received earnest consideration in this country, and that a serious attempt has been made to attack it by the appointment in 1915 of the Committee of the Privy Council for Scientific and Industrial Research. The Committee consists, of course, of a number of important political personages, mainly distinguished for their lack of knowledge of both science and industry. It is, however, supplemented by a small Advisory Council, most of the members of which are eminent men of science. So far the Committee has done but little, though this fact is largely due to the difficulty of getting men to attend to anything other than the urgent national war work to which all our energies are being devoted for the moment. The Germans, on the other hand, have sought to attain their object by forming the "German Union of Technical Scientific Societies," which is a combination of some thirteen associations interested in various branches of technology. The object is stated to be the establishment of a balance between science and practice, seeing that most technical tasks require the collaboration of several distinct branches of science.

One of the first steps of this Union has been the creation of a department to act as an intermediary between the scientific branches of the universities and technical colleges and the various industries, for carrying out scientific and technical researches that may be of value to the latter, and the Union has issued an appeal to industries to submit their problems and difficulties to it for the purpose of having these investigated by competent scientific authorities whom the above-named department is in a position to select. It is rather disquieting to find that the German method of attacking the question is an individualistic one to the extent that it is the industries themselves and the scientific and technical institutions which propose to find the necessary funds and to provide the means of solving their own difficulties, whilst we in this country, who have hitherto been proud of our individualistic principles, which have ever formed the basis of Britain's industrial greatness, are content to sink our individualism and to ask a Government Department to solve our industrial problems for us.

The German Iron and Steel Institute has taken a prominent part in the extension of the research movement. This institute joined the above-mentioned Union of Technical Scientific Societies at an early stage, and took an active share in its formation; it has furthermore founded a research institution of its own for the investigation of problems connected with iron and steel manufacture. Here, again, it is characteristic of the quite modern trend of German methods that the iron and steel industry proposes to provide practically the whole of the important funds required for such an institution, whilst the town in which this is to be built will have to provide a suitable building site and a contribution to the cost of erecting the buildings. Although we in this country have not been unmindful of the need for applying scientific research to the numerous problems that arise in iron and steel manufacture, we have attempted nothing on the scale of this projected German institution to be devoted entirely to this need. For example, the Alloys Research Committee of the Institution of Mechanical Engineers had an excellent piece of work to its credit. Thanks to the munificence of Mr. Andrew Carnegie, our own Iron and Steel Institute, too, has been enabled to assist and encourage research for the past seventeen years; but this has been done on quite different lines. The Carnegie Fund enables scholarships to be awarded, the holders conducting a specified research in the metallurgy of iron and steel at any suitable university, technical school, or works, the results being communicated to the Iron and Steel Institute, and in this way a great deal of useful and valuable work has been done. It is unquestionable that an institution equipped and maintained for such researches in any of our great metallurgical centres could do even better work than is possible to workers widely scattered, not provided with the best possible equipment, and each probably in ignorance of what the others are doing. It cannot be suggested that our iron and steel industry is less capable of providing the requisite funds, and, seeing that every single important invention in iron and steel manufacture has emanated from this country, it cannot be supposed that British metallurgists are less capable of conducting such researches or of applying their results; there is therefore no reason whatever why we cannot do here what the Germans are proposing to do, and do it at least as efficiently.

The other movement, too, for a more intimate union and a closer co-operation amongst the leading technical societies, is one that deserves equally to be imitated in this country. The first step ought to be joint action amongst our technical societies, above all between those connected with the mining, metallurgical, and allied industries, the key industries of our national prosperity; they ought to have a joint building in which they could all be housed, forming a common meeting place for all, with suitable laboratories, and, in particular, one common library in which the whole of the world's technological literature could be found readily accessible to every student or inquirer. Such a library alone would save as much time and money, merely by avoiding the vast duplication of efforts that is now going on, as would give an adequate return upon its cost, not to mention the new vistas of study that it would open up. A building of this kind already exists in New York, where some of the most important of the technical and engineering societies are housed under one roof, to their very great mutual advantage. If we had such a building in London it might very beneficially shelter also the new Imperial Bureau of Mineral Resources, which would become immensely more useful if it were thus in close and constant touch with the chief technical societies and through them with the industries themselves. The technical societies, on the other hand, would gain by being able to communicate directly with the Government Department with which they would be chiefly concerned, and could work with it whilst at the same time preserving their independence, thus gaining the advantage of Government support without the risk of being strangled by administrative red-tape. H. L.

CONFERENCE OF UNIVERSITIES.

AN important conference which met at the Imperial Institute on May 10 was attended by about seventy representatives of the universities of the United Kingdom and also by Mr. Joynt, representing New Zealand, Prof. Bragg, representing the universities of Australia, President Tory, representing the universities of Canada, and Prof. Gilbert Murray, Acting-Director for the Board of Education of Special Inquiries and Reports. Sir Donald Macalister was voted to the chair.

Matters arising out of a private and preliminary conference at the Foreign Office were considered. A committee was appointed to advise the Government with regard to representatives of British universities to take part in Mr. Balfour's Mission to the United States. The vice-chancellor or principal of each university, or a deputy appointed by him, together with the executive committee of the Universities Bureau, were appointed to consider any matters of common interest arising out of the proceedings of the conference or submitted to it by the Government.

The title of the degree to be obtainable by students of the King's Dominions overseas or of foreign countries as the result of post-graduate work and research was discussed at considerable length, revealing a much higher degree of unanimity than seemed to be likely when the conference met a year ago.

It was recognised by the conference that the question of the title of a degree and the conditions under which it could be obtained were of far greater import than the influence which the degree might have in attracting graduate students to the United Kingdom. It involves the whole question of the function of universities in the modern world. In our own country the tradition still lingers that a university is a place of post-school education, whereas in the modern world there is greater need for the provision of highly trained men and women capable not merely of absorbing knowledge, but also of increasing the common stock. This position was well defined by Sir Ernest Rutherford, whose speech may be quoted as an epitome of the views of the conference:—

It should be made clear that the new degree which many universities propose is an entire innovation. It will involve a full period of post-graduate training, introducing into Britain a system practically identical with that which obtains in America, and to a large extent in Canada also. It is of great importance that it should be adopted by the English-speaking world. In Britain it is likely to be a degree of very high standard, because we have the opportunity of building it on an honours basis. It is generally considered that the course should last for not less than two years, and this, I consider, is as it should be for a student who has already taken an honours degree, say in the first class, before he starts post-graduate work and investigation. If he shows promise and ability he will be able to take the M.A. in a year. We must also consider those who come to us from a distance, who will already in many cases have done a certain amount of research. It will be a real and very great departure in English education—the greatest revolution, in my opinion, of modern times. It is true that some universities have already attempted post-graduate training in a somewhat spasmodic manner. To carry out the scheme in its entirety will involve a much larger and more highly specialised staff and much more money for equipment.

NOTES.

We deeply regret to announce that Sir Alexander Pedler, F.R.S., died suddenly on Monday, May 13, at sixty-eight years of age, while attending a committee meeting at the Ministry of Munitions. Sir Alexander was formerly Vice-Chancellor of the University of Calcutta and Director of Public Instruction for Bengal. He retired in 1906, and since 1907 had been the honorary secretary of the British Science Guild, as well as an active member of many other public and scientific bodies.

We learn with great pleasure that Oliver Heaviside has been elected an honorary fellow of the American Institute of Electrical Engineers. He is the fifth honorary fellow, the others being Marconi, Ferranti, Blondel, and C. E. L. Brown. Heaviside has often contributed to our columns on scientific theory and on educational matters. He holds very strong views about the mathematical teaching that used to be given in our schools, and has little patience with concentration upon its logic and philosophy. In his own books he does not spare the reader, but makes him master his own peculiar nomenclature and notation before he can learn those principles of electromagnetic theory which he has developed so successfully, and some of which are of great importance to practical engineers. His books would have a far wider vogue if he had conformed more to conventional methods, but the value of his work would probably have suffered, and he would have lost much of the pleasure which he obviously felt in writing them. Standardisation has its uses, but it has also serious limitations. Many of us are grateful to Lodge, Perry, and Searle for explaining many of the good things in his books which we might otherwise have passed over. From the practical point of view Heaviside's most important discovery was the "distortionless" circuit for speech transmission and his suggestion of the use of inductance coils at intervals in long telephonic lines. This suggestion was taken up and developed by Pupin and other American electricians, and has been largely and most successfully utilised in many submarine telephone lines all over the world. We rejoice that our American *confrères* have done Oliver Heaviside honour; we thank them and offer to him our warmest congratulations.

The Pereira medal of the Pharmaceutical Society of Great Britain has been awarded to Miss H. C. M. Winch.

Lord Rothschild has been elected an honorary member of the Entomological Society of Spain, of which we recently noted the foundation.

The Decimal Association informs us that the Federation of British Industries, by a unanimous resolution of the executive council, has now given its support to the Decimal Coinage Bill which is before the House of Lords.

Mr. W. B. Randall, of Waltham Cross, has generously provided funds for the establishment of a new research post at the Rothamsted Experimental Station, and the committee has appointed Mrs. D. J. Matthews (formerly Miss Isgrove) to occupy it. Mrs. Matthews will devote herself to the study of some of the problems connected with soil sterilisation as it is now being carried out in certain types of nurseries.

The annual congress of the South-Eastern Union of Scientific Societies will be held at Burlington House on May 29–June 1, and will follow the usual lines. The president will be Sir Daniel Morris, who will deliver his address on the evening of Wednesday, May 29, when his subject will be "A Chapter in the Geographical Distribution of Plants." On Thursday evening, May 30, at 8 p.m., Sir Ronald Ross will open a discussion on mosquitoes in England.

The death is announced, on May 12, of Dr. R. G. Hebb, consulting physician and physician pathologist to Westminster Hospital, lecturer on pathology at Westminster Hospital Medical School, reader in morbid anatomy at the University of London, and editor of the Journal of the Royal Microscopical Society.

We regret to record the death at Newcastle-upon-Tyne on May 7 of Sir William Haswell Stephenson, aged eighty-two years. Sir William joined the Tyne Improvement Commission in 1878, and from 1900 until his death was chairman. It was during his long *régime* that the building of large ships became possible. He was an honorary D.C.L. of Durham University, and the honour of knighthood was conferred upon him in 1900.

THE General Congress of Civil Engineering, which was held in Paris on April 18–23, proved an entire success. A total of 151 reports were printed and circulated to the members and discussed at the sessions of the congress. The sections of the congress were:—(1) Public Works and Civil Engineering, (2) Transport, (3) Mechanical Engineering, (4) Mining and Metallurgy, (5) Industrial Physics and Chemistry, (6) Industrial Electricity, (7) Rural Engineering and Agriculture, (8) Industrial Organisation, (9) Social Hygiene and Welfare, and (10) Industrial Legislation. In the economics section much attention was given to educational reform and to the future training of the worker and the engineer.

WE have received a pamphlet entitled "Building Jerusalem" (from a line of the poet, William Blake), being the annual report of the National Council of Public Morals. It is noted that action has been taken on the recommendation of the council's national birth-rate commission in scheduling as a poison certain forms of lead which have been extensively used as abortifacients. During the past year a commission of inquiry on the physical, educational, and moral influence of the kinematograph has completed its labours and published a useful report. Valuable propaganda work has also been done for furthering the establishment of a Ministry of Health, and pamphlets for the troops and for the civil population on venereal disease have been issued together with other publications.

A NUMBER of further cases of the disease resembling botulism (see NATURE, May 2, p. 170) have been reported in London and Birmingham. The epidemic has assumed sufficient proportions for the medical officer of the Local Government Board to issue a memorandum to health authorities describing the symptoms, etc., and the London County Council has decided to place at the disposal of medical practitioners in London the services of its medical staff for consultation. Considerable doubt exists as to the disease being botulism. So far we believe the *Bacillus botulinus* (the causative microbe of botulism) has not been isolated in connection with the present epidemic, which has also not been associated with any particular article of food. It is suggested that the disease may be a cerebral form of poliomyelitis, which in its spinal form occurs in epidemics and principally attacks children, causing infantile paralysis.

SIR ROBERT HADFIELD has been for some years a strong advocate of the scheme for erecting a joint home for technical associations connected with the metal industry, including the Institute of Mining and Metallurgy, the Iron and Steel Institute, the Institute of Metals, and the Institution of Mining Engineers, none of which has at present adequate accommodation. It is estimated that the cost of a suitable building would amount to 400,000*l*. Besides providing a common meeting-place for the bodies concerned with the metal industry, the scheme would render possible a joint library, an advantage which has been strongly emphasised in the experience of the United Engineering Societies Building in New York. The council of the Iron and Steel Institute has approved the scheme, and it is probable that the Sheffield City Council, and possibly the Cutlers' Company and the Chamber of Commerce, will be invited to consider it.

A REPORT has been issued summarising the work of the Industrial Reconstruction Council during the three months ending March 31. It will be recalled that the first public meeting of the council was held at the Guildhall on February 15, when representatives of a large number of trade unions and trade associations were present. Meetings have since been held in Bristol, Manchester, Edinburgh, and Nottingham, addresses being delivered by Lord Balfour of Burleigh, Mr. E. J. P. Benn, the Rt. Hon. Christopher Addison, the Rt. Hon. G. H. Roberts, Sir William McCormick, and others. Conferences have also been arranged with the officers of the Federation of British Industries, the Manufacturers' Section of the London Chamber of Commerce, and the Engineering Employers' Federation. The council emphasises the need for educational work amongst both employers and employees, and of increasing the number of lecturers and speakers who are willing to explain the principles of the Whitley report. It is hoped that branch organisations will shortly be established.

"FISHERIES NOTICE No. 9," just issued by the Board of Agriculture and Fisheries, is a practical description of methods of eel-capture. The pamphlet is well illustrated, showing the details of construction of traps and weirs, and it includes a list of makers of the fishing gear mentioned. Copies may be obtained, free of charge and postage, on application to the Secretary, Board of Agriculture and Fisheries, 43 Parliament Street, London, S.W.1. The Fresh-water Fish Committee (54A Parliament Street) also issues a notice relative to the distribution of elvers for stocking lakes, reservoirs, farm-ponds, marsh drains and pools, and the upper parts of suitable river systems. It is estimated that 1000 elvers per acre is an adequate supply where eels are scarce. About three to four years are required before the elvers grow to marketable-sized eels. Full directions are given in the notice to which reference is made. The cost of the elvers is from 3*s*. 6*d*. per 1000 to 2*l*. 5*s*. per 20,000. These notices are deserving of wide publicity, and should be obtained by all persons who have control of suitable waters for rearing purposes.

A GANG of riveters at the works of Messrs. Fraser and Fraser, Ltd., Bromley-by-Bow, celebrated *Lusitania* Day by creating a world's record in rivet-driving. The squad consisted of the riveter, Mr. R. Farrant, who used an Ingersoll-Rand "Little David" pneumatic riveter, weighing 28½ lb., a holder-up using a hand-tool weighing 16 lb., and five other men or boys. The rivets were ½ in. in diameter by 1⅛ in. long. The following particulars—extracted from the *Engineer* for May 10—are of interest in showing the rates for different periods of the day:—

Time	Rivets driven	Rate per hour
6.30 a.m.	nil	—
7.30	536	536
8.30	1032	494
Half-hour interval.		
9.30 a.m.	1304	544
10.30	1823	519
11.30	2257	434
1.0 p.m.	2920	442
One-hour interval.		
2.30 p.m.	3100	360
3.30	3550	450
4.30	4007	457
5.0	4276	538

The average for the day of nine hours is one rivet per 7.58 second. The American record of 2720 rivets in nine hours, held by Charles Schock, has been beaten by 57 per cent., although it is only fair to say that full information is lacking regarding his performance, and hence strict comparison is not possible. A note in the *Times* of May 15 states that Farrant's record of 4276 rivets has been beaten by a workman in Messrs. Beardmore's yard at Dalmuir. Working the usual shift of nine hours on ship's plates, the man drove 4452 rivets, 176 more than Farrant's total.

THE first instalment of an interesting article on the Larderello natural steam power plant, by Ugo Funaioli, director of the electrical department of the Società Boracifera di Larderello, appears in *Engineering* for May 10. Reference has already been made in NATURE to the utilisation of volcanic heat in Tuscany, and the present article gives an account of the method employed in boring for steam. Heavy steel chisels are attached to a rigid system of iron rods, and the whole system is lifted by an electric winch and then released, the fall causing the chisel to penetrate the soil. Steam and water are found generally at a depth of 20 m., and the work from that point proceeds with increasing difficulty and requires specially trained workmen. Diameters of bore of 40 cm. have been attained, and experiments are being made to arrive at still larger diameters in order to augment the output of steam. The holes are lined with iron tubes so as to prevent crumbling of the sides, and the tubes are welded together with oxy-hydrogen flame; the oxygen and hydrogen required are produced locally by the electrolysis of water. When it is judged by signs known to the practised eye of the foreman that the hole has reached a sufficient depth, a curious operation termed locally "sfulminazione" (explosion) is sometimes performed, which clears the hole from all remaining *débris* and of the water which balances the pressure of the steam. A sort of rough piston is introduced into the hole, and is afterwards withdrawn as rapidly as possible by means of the electric winch. If all necessary conditions are fulfilled this provokes a small volcanic eruption, and the hole emits violently mud, stones, and boiling water. This eruption lasts for some minutes, and is followed by the steady emission of dry steam.

THE inaugural meeting of the Société de Chimie Industrielle was held recently at Paris under the presidency of M. Clémentel, Minister of Commerce, who was introduced by M. P. Kestner, president of the society. An important paper was read by M. Matignon on the problem of the production of synthetic ammonia before Haber. M. Matignon pointed out that the first steps in this direction were due to an English chemist, Perman, who showed in 1904 that the combination of nitrogen and hydrogen to form ammonia and its resolution into these elements form reversible reactions depending upon certain conditions of equilibrium. These conditions and the amount of ammonia producible thereunder were studied in the following year by Haber and one of his pupils, Van Ordt, and as a result of these studies a works for the annual production of 30,000 tons of ammonium sulphate was erected at Oppau, near Ludwigshafen. The first patent, however, bearing on this subject is dated so far back as July 11, 1865, being an English patent taken out by Dufresne in the name of Charles Tellier for the preparation of oxygen, in which he claims the utilisation of the nitrogen eliminated in his process by passing it over spongy iron heated to redness, and afterwards passing hydrogen over the combination of iron and nitrogen thus formed, when a large quantity of ammonia is at once generated. A French patent was taken out by Tessié du Motay in 1871 for similarly employing nitrides of titanium. In 1881 Charles Tellier took out further French and German patents for the production of ammonia from atmospheric nitrogen by means of iron and titaniferous iron. Further work in this direction was done by Ramsay and Young in 1884, and patents were taken out by Hlavati in Austria in 1895, and in France by the Christiania Minekompani in 1896, and again by M. Le Chatelier in 1901. Perman had, moreover, pointed out the effect of numerous metals as catalytic agents in the combination of nitrogen and hydrogen, also the advantage of employing high pressures. It would, therefore, appear probable that the monopoly of the rights in the production of synthetic ammonia, which the Badische Company lays claims to, is likely to be invalidated by the publication of the above list of patents.

IN an article entitled "Psychology in Relation to the War," in the *Psychological Review* for March last, Major R. M. Yerkes, of the United States Army, and president of the American Psychological Association, reports upon the organisation of American psychologists for military service during the year 1917. In April, 1917, twelve committees were appointed from the members of the American Psychological Association "to render the Government of the United States all possible assistance with psychological problems arising from the present military emergency." The subjects allotted to these various committees included the psychological examination of recruits, the selection of men for tasks requiring special aptitudes (*e.g.* artillery service, signalling, etc.), psychological problems of aviation, problems of "incapacity" (shell-shock, re-education, etc.), recreation in the Army and Navy, psychological and pedagogical problems of military training and discipline, and visual and acoustic problems in relation to military service. For obvious reasons a detailed report upon the later activities of some of these committees cannot be given, but the account of the work of the committee for the psychological examination of recruits well repays study. The purposes of the psychological tests applied were:—"(*a*) To aid in segregating the mentally incompetent; (*b*) to classify men according to their mental capacity; (*c*) to assist in selecting competent men for responsible positions." It is important to notice that of the number so tested, the lowest (10 per cent.) and the highest (5 per cent.) were subjected to a more searching individual examination, on the basis of which a report was made by the psychological examiner to the medical officer. As a result of an examination of 5000 officers and 80,000 men, the Medical Department recommended the extension of psychological examining to the entire Army. In December, 1917, this recommendation was approved by the General Staff, and the section of psychology in the Surgeon-General's Office is engaged in the preparation of a plan for this work. We are now informed that a division of psychologists has been organised, consisting of twenty-seven majors, fifty-two captains, and sixty-two lieutenants, with six hundred assistants.

Two forms of "Githathi," or magic stones, in use among the AKikuyu are described and figured by Mr. H. R. Tate in the Journal of the East Africa and Uganda Natural History Society, vol. vi., No. 12. The larger of these is circular, the smaller cylindrical, in shape, and both have been drilled through the centre. The use of such stones seems to have fallen into desuetude; but Mr. Tate has been able to show that they were used to invoke vengeance, or to obtain compensation for offences against tribal law. Mr. Hobley, some years ago, was fortunate enough to witness a trial by ordeal as practised among the Akamba of Kilima Njaro, in which one of these stones was actually used. In the same issue of this journal

Mr. G. M. Dobbs describes a small stone bowl found at the entrance to a cave in Sotik. None of the natives living in the neighbourhood had ever before seen such a bowl, and could offer no suggestions as to its probable use; hence it is evident that it is a relic of some extinct tribe, of which more may be discovered later. He also describes some remarkable circular holes found all through the district from the Nyando River to Sotik. Arranged in groups of from ten to twelve, each hole is provided with an entrance in the form of a long narrow passage. But there is nothing in the form either of the passage or of the pit itself to afford a clue as to the uses to which the excavations were put. By the present native population of the Lumbwa country they are said to have been made by a tribe called the Sirikwa, now, apparently, no longer in existence. The only other trace of this tribe now remaining exists in the form of fragments of red pottery of a type now unknown in the country. In placing these evidences of vanishing and vanished races on record, the society is doing some extremely valuable work.

In the March issue of the *Journal of the Board of Agriculture* Messrs. E. S. Salmon and H. Wormald give an account of an experiment in the treatment of "covered smut" (*Ustilago hordei*) of barley. Seed from an affected crop was secured for the purpose, and separate portions of this were treated with copper sulphate (2½ per cent.), Bordeaux mixture, and formalin respectively, whilst a fourth portion was subjected to "sweating" in a malt kiln. Plots, each two acres in extent, were sown with the treated seed, whilst a fifth plot of one acre sown with untreated seed served as control. The results were assessed by counting the plants with smutted ears growing in the six outside rows along each side of each plot, the area thus covered by each separate count being, roughly, one-tenth of an acre. The formalin treatment proved completely successful, whilst the treatment with copper sulphate, though less effective, greatly reduced the extent of the attack. On the other hand, neither "sweating" nor the treatment with Bordeaux mixture afforded any measurable protection.

The depressing effect of weeds upon the growth of accompanying crops has in the past been commonly regarded as either an effect of competition for the available soil nutrients or a shade effect, although in recent years increasing support has been given to the view that toxic excretions from the roots may play a very great part. This latter view receives little support, however, from the experiments carried out at Rothamsted during the last four years by Dr. Winifred E. Brenchley, the results of which are summarised in the March issue of the *Journal of the Board of Agriculture*. Pot- and water-culture experiments, in which poppy, spurrey, blackbent, and charlock have been grown separately and together with wheat and barley under varying degrees of competition, have shown that the association of any of the weeds with wheat had a great influence upon the growth of both, the results varying according to the species of weed introduced. The presence of extra wheat plants produced an effect similar to that of weed plants, the depreciation in individual growth being indeed, in some cases, much greater than was caused by the weeds. From a survey of the whole series of experiments it seems probable that the essential factor in the relation of crop with weed is that of competition for food, space, and light rather than that of toxic excreta from the roots. The mere competition of plant with plant, irrespective of species, has much to do with development, the chief factors involved being the time and duration of competitive check. The possibility of toxic action cannot be ruled out entirely, but it is evident that any such action is easily masked by the many other factors of competition, such as root interference, crowding of aerial parts, and deficiency of plant food.

The late Prof. F. E. L. Beal attained a world-wide fame as the result of his minute studies on the food and feeding habits of wild birds, and in the recently issued Bulletin No. 619 of the U.S. Department of Agriculture, treating of the food habits of the native swallows, his reputation is fully maintained. The paper is characterised throughout by ripe experience, scrupulous detail, and a broad grasp of the subject. The stomach contents of the seven species dealt with have been carefully examined, 2030 specimens being utilised in determining the nature of the food, and, as was to be expected, they prove, in their relation to man, to be as harmless as any family in the bird kingdom. They are practically wholly insectivorous, the major portion of their insect food consisting of injurious species. In only a single species, the tree-swallow (*Iridoprocne bicolor*), was there any appreciable amount of vegetable matter; here it reached 19·5 per cent., and consisted chiefly of the fruit of the bayberry and a few weed seeds. Curiously, in this species Diptera form the largest item of the food, viz. 40·5 per cent.; these were taken throughout the year, the highest percentage (89·5) being reached in November. The relative proportions of the different elements of food of the seven species were as follows:—Weevils, 4·2; other beetles, 11·8; ants, 9; other Hymenoptera, 16·7; Hemiptera, 17·2; Diptera, 26·9; Lepidoptera, 2·7; Orthoptera, 0·4; other insects, 7·8; other animal food, 0·3; vegetable food, 3 per cent. On the whole, we may say that the bulk of the food consists of beetles, Hemiptera, Hymenoptera, and Diptera. Lepidoptera are only sparingly eaten, the larvæ not being readily taken on the wing. From time immemorial these birds have been of the greatest economic importance to man; indeed, it is questionable if there is any other family of birds so wholly and directly useful to mankind, and their strict preservation should be a duty of every State.

Some Chinese contributions to meteorology are described by Co-Ching Chu in the *Geographical Review* (New York: American Geographical Society, February, 1918). Although several meteorological instruments had been invented and weather proverbs are numerous, systematic study of meteorological problems appears to have been introduced only with the Western sciences. The kite was known at a very early date, probably about four centuries before Christ, but was only employed in warfare and not for meteorological observations. Chang Hun, who invented the seismograph, lived from A.D. 78 to 139. He also calculated π to be the square-root of 10. Wind vanes are occasionally referred to in Chinese writings, as also rain gauges, but the earliest references to the latter are in Korean writings (A.D. 1442). Evidence shows that the Chinese had discovered the magnetic compass at least 700 years before its use by Columbus. Sun-spots were observed in China from 28 B.C. onwards, and are described as visible to the naked eye in A.D. 321. On the other hand, the thermometer and hygrometer were first introduced into China by Ferdinand Verbiest (1623–88), a disciple of Tycho Brahé, the instruments in question being an air thermometer and a hygrometer of gut, which Verbiest himself invented.

Prof. R. S. Lull discusses (*Amer. Journ. Sci.*, vol. xliv., p. 471, 1917) the alleged "sacral brain" of Dinosaurs, an enlargement of the spinal column that has been specially studied by him in Stegosaurus. In spite of Branca's contention, he feels that no unusual function can be ascribed to such enlargements, other than "the normal one of transmission and reflex action in an unusual degree." The discussion involves interesting remarks on the mode of life of the large Dinosaurs.

An interesting review of field observation and laboratory work on the problems of dynamic metamorphism in rock masses is given by Sir Jethro Teall in the Proceedings of the Geologists' Association (vol. xxix., p. 1, 1918). The famous Scourie dyke is again considered, and the flow of the Lizard rocks under pressure is imitated experimentally in blocks of heterogeneous clay.

An important memoir by Messrs. A. S. Kennard and B. B. Woodward on "The Post-Pliocene Non-marine Mollusca of Ireland" appears in the Proceedings of the Geologists' Association (vol. xxviii., p. 107, 1917). The authors conclude that, "with the exception of two or three species which may have been accidentally introduced by man, all the species existed in Ireland in pre-Glacial times and survived the Glacial period." The Chara deposits often found beneath peat are held to indicate a warm epoch, when they were formed in shallow meres liable to desiccation in the hot summers. Under such conditions the plants become white and brittle, and break up to form a "marl." The raised beaches of the north-east belong to the same epoch. A damper time followed; but the cold epoch postulated in Prof. F. J. Lewis's series is not recorded by the mollusca. A just tribute is paid to the unflagging work of Mr. R. Welch, of Belfast.

The *Boletin oficial de minas y metalurgia* publishes a report on the mineral production of Portugal (quoted in *Le Génie Civil* for April 27). The minerals exploited have been particularly uranium (1307 tons), wolfram, tin, copper, and iron. The total production of metals in Portugal in 1914 was only 455 tons, as against 845 tons the previous year.

Elektrotechnik und Maschinenbau for October 24, 1917, describes new types of platinum-iridium thermocouples for recording rapid changes of temperature. One type consists of wires 0·02 mm. in diameter, in the proportion of sixty-five parts platinum and thirty-five parts iridium. The maximum range of the combination considered is 1850° C.

In the *Zeitschrift des Vereines deutscher Ingenieure* for December 8 last, Max Berlowitz discusses the improvements that have been made in the design of micromanometers. He also gives a detailed description of a recent instrument invented by Rosenmuller, which has the great advantage of a fixed zero. The author also describes a new method of standardising the micromanometer, and gives a table of simplified calculations for use with the instrument.

Prof. Doelter, in *Die Zeit* (March 13), describes the phosphate deposits of the Ukraine. These deposits occur in the Silurian formation, chiefly in Podolia and Bessarabia, and also to a great extent on the banks of the Dniester and the Ladova, where it is obtained in lumps. The mineral is phosphorite, and contains considerable calcium phosphate, which yields 27½ per cent. of phosphoric acid. There are numerous phosphorite deposits in other districts.

A German patent has been granted (*Elektrotechnik und Maschinenbau*, April 25, 1917) for manufacturing electric condensers by covering a surface of metal with an elastic medium that adapts its shape to that of the metal. The tissue is then impregnated with a substance to render it dielectric, and a second sheet of metal forms the other plate. German Patent No. 291,923 (*Zeitschrift für Mechanik und Optik*, February 1, 1917) describes a condenser formed by a glass dielectric upon which a very fine film of lead is squirted.

Messrs. Blackie and Son, Ltd., are publishing in two volumes, under the title of "Applied Optics: The Computation of Optical Systems," an edited translation, by J. W. French, of Steinheil and Voit's "Handbuch der angewandten Optik." Vol. i. is ready. Vol. ii., which is in preparation, will deal with the determination of refractive indices and dispersions and the computation of achromatic prisms, with the computation of doublet objectives; also with the discussion of the aberrations of different combinations. In addition, it will contain appendices on "The Determination of the Refractive and Dispersive Powers of Various Media" and on "The Trigonometrical Formulæ for the most General Case of the Refraction of Light by a System of General Surfaces."

OUR ASTRONOMICAL COLUMN.

Nova Monocerotis.—Additional particulars of the new star in Monoceros, which was discovered by Wolf on February 4 (Nature, vol. ci., p. 52), are given in *Popular Astronomy* for April (vol. xxvi., p. 282). The position of the star for 1918·0, as determined by Prof. Barnard, is given as R.A. 7h. 22m. 46·93s., decl. $-6^\circ 30' 34{\cdot}7''$. According to observations made at the Lick Observatory, the spectrum has reached the nebular stage, consisting of extremely broad bright bands of hydrogen, with the nebulium lines moderately strong and absorption near the centres of the green bands. Photographs taken at Harvard on February 21 show the bright hydrogen lines α to ζ, and bright lines also appeared at wave-lengths 4363, 4520, 4686, 5007, 5440, 5630, and 5750.

The Atomic Weight of "Nebulium."—In a more complete investigation of the periods of vibration of a single-ring atom, taking account of the magnetic and associated mechanical forces on an electron due to its motion, Prof. J. W. Nicholson has made a more precise calculation of the atomic weight of "nebulium" (Monthly Notices, R.A.S., vol. lxxviii., p. 349). Adopting Wright's values for the two lines λ 5006·89 and λ 4363·37, it results that $m/M = 0{\cdot}000415$, where m is the mass of the electron and M that of the atom of nebulium. Since the mean of the best determinations of the corresponding ratio m/H for the hydrogen atom is 0·000545, it results that the atomic weight of nebulium is 1·31, the possible error being unity in the last figure. From observations of the limiting order of interference for the line λ 5007, Prof. Fabry had previously shown that the atomic weight was probably between those of hydrogen and helium.

Hyderabad Astrographic Catalogue.—The work on the astrographic catalogue at the Nizamiah Observatory, Hyderabad, has been carried on with extraordinary vigour since the appointment of the present director, Mr. R. J. Pocock, in 1914. The seven zones from 17° to 23° south declination were originally assigned to the Santiago Observatory, but on account of the long delay in commencing operations the Hyderabad Observatory was afterwards invited to undertake the zones -17° to -20°. Little was done before Mr. Pocock took charge, but the telescope was got into working order and regular work on the catalogue commenced in December, 1914. The first volume of the catalogue has just been issued, comprising measures of rectangular co-ordinates and diameters of 63,436 star-images on plates with centres in declination −17°. The form of the catalogue is generally similar to that adopted at Greenwich and Oxford, the measures for each plate being accompanied by an equation for the conversion of measured diameters to magnitudes, and the plate constants required for conversion to standard co-ordinates. The reduction of measured to standard co-ordinates, and thence to right ascension and declination, is fully explained in the introduction, and tables are provided to facilitate the computations. A supplementary catalogue gives the standard co-ordinates of the reference stars. All the plates reach at least to the 12th magnitude, and some include stars fainter than magnitude 13. The whole work reflects great credit on the director and his assistants.

THE CO-ORDINATION OF SCIENTIFIC PUBLICATION.

THE co-ordination of scientific publication formed the subject of a recent conference arranged by the Faraday Society under the chairmanship of Sir Robert Hadfield, when a number of interesting problems bearing on the desirability of a fuller co-operation amongst our scientific and technical societies were discussed. Both in the reading and publication of papers there is, at present, a considerable amount of overlapping and lack of co-ordination, with the result that much valuable work is either lost or overlooked owing to communications being made to societies which are not especially associated with the subject-matter of the investigations concerned, and much benefit would undoubtedly result from a federation of interests in this respect. Whilst there is a general consensus of opinion that it is essential to maintain the individuality of each society in regard to the reading and publication of papers, and that any attempt to pool communications for later distribution by a central organisation is undesirable, much effective co-operation could be secured between kindred societies by the arrangement of joint meetings and conferences with the object of promoting united work on problems of common interest. Borderland subjects merit special consideration from this point of view.

The publication of the proceedings of such meetings in the Transactions of the several societies concerned would be much facilitated by the adoption of a uniform size and type for the publications of societies dealing with allied subjects, so that each could include such papers in its journal or distribute them as self-contained reprints of a standard size. Similar uniformity is perhaps not practicable for all scientific and technical publications, but in so far as it can be adopted it would add much to the accessibility and the utility of the recorded work.

Organised collaboration is also desirable by means of which the members of scientific and technical societies should have opportunity of knowing what papers are being contributed to societies other than their own, apart from their later publication either in the journal of the society concerned or in the form of abstracts. The proposal, which, it is understood, is being considered by the Board of Scientific Societies, to publish a weekly journal of announcements would meet this want, and it is to be hoped that the Board will decide to issue such a publication as soon as possible. Meanwhile, individual societies could aid in this direction by publishing in their journals both the announcements of cognate societies and short summaries of papers read previous to publication, so that the subject-matter is brought to the notice of those interested at as early a date as possible. A method of mutual exchange to facilitate such co-operation could be easily arranged, and would in no way detract from, but rather add to, the interest in the later full publication of papers.

Apart from original contributions, the publications of most societies include abstracts of scientific and technical literature published both in our own and in foreign journals. In so far as such abstracts include subjects of common interest to members of kindred societies, there is at present a great deal of overlapping which could be advantageously eliminated by organised collaboration. We have, in the past, been far too reliant in many subjects on the foreign, and especially on the German, journals for our supply of the world's scientific and technical literature, and it is high time that we became independent and self-supporting in this respect. Effective co-operation should achieve this desirable end for each group of cognate subjects; and whilst the method of collaboration would depend to a considerable extent on the character of the subject, a common journal of abstracts for each group of societies would, in the majority of cases, prove the most advantageous plan. Although a scheme of this character would necessarily decrease the bulk of the publications of each society, the original contributions which mark their individuality would be given greater prominence, time wasted by the re-reading of the same abstract in several journals would be saved, and considerable economies in publication would be effected.

Much attention is being directed at present towards the unification and co-ordination of scientific effort. The co-ordination of scientific publication, which has made some progress in the directions indicated during recent years, should certainly continue to occupy a prominent place amongst these problems of reconstruction.

THE DIURNAL VARIATION OF TERRESTRIAL MAGNETISM.

PUBLICATION No. 102 of the Royal Meteorological Institute of the Netherlands consists of a doctor's dissertation in Dutch by Miss Annie van Vleuten "On the Diurnal Variation of Terrestrial Magnetism" and two short papers in English from vol. xxvi. (1917) of the Proceedings of the Science Section of Kon. Ak. v. Wet. of Amsterdam. The dissertation, which extends to 106 pages, contains numerous tables of diurnal variation data for the magnetic elements, and the corresponding Fourier coefficients for a number of stations, more especially for Pavlovsk, Sitka, Irkutsk, De Bilt, Cheltenham, U.S., Zi-ka-wei, Honolulu, Bombay, Buitenzorg, and Samoa, and for the group of years 1906–8. The Fourier coefficients, based on the data from these ten stations from the international quiet days, five a month, are used to furnish answers to the questions advanced in the two short papers in English: (1) Does the internal magnetic field to which the diurnal variation is partly ascribed depend on induced electric currents? (2) Do the forces causing the diurnal variation possess a potential? These are problems chiefly associated in England with the name of Prof. Schuster, to whose work there are many references, while abroad they have occupied, amongst others, Profs. Fritsche and Steiner. Schuster and Fritsche, using totally different observational data, separated the forces causing the diurnal variation into one set having a source external to the earth, and a second set having an internal source. Schuster suggested that the second set arise from currents induced in the earth by the former set. Steiner, employing Fritsche's results, decided against Schuster's hypothesis. Miss van Vleuten's material is at once more homogeneous than Fritsche's, and more representative than Schuster's. She concludes that, while the terms of higher order accord pretty fairly on the whole with Schuster's hypothesis, this is not true of the principal terms of lower order. The natural inference is that the hypothesis is, at best, not a complete explanation of the phenomena. To the second question the answer obtained is that the forces causing the diurnal variation do *not* possess a potential; part, but only part, of the diurnal variation may be derived from a potential. Besides the main data mentioned above, data from a number of other stations are utilised, and there is, besides, a good deal of mathematical theory. While the publication makes most direct appeal to theorists, it contains much valuable information as to facts not otherwise readily accessible.

GALVANOMETRIC RECORDS OF EMOTIVITY.

In the correspondence columns of the issue of the *Lancet* for February 23, Dr. A. D. Waller described some very interesting results which he had obtained by the study of the "emotive response" or "psycho-galvanic reflex" on various individuals. If, by means of electrodes applied to the dorsum and palm of the hand, a subject be connected in series with two Leclanché cells and a galvanometer, an emotive response is shown by the deflection of the latter, not only to physical stimuli such as burning, unexpected noise, smell (*e.g.* a poison gas), but also to psychical stimuli such as apprehension, questions, and thoughts, pleasant or unpleasant. The normal resistance between the back and the palm of the hand is between 10,000 and 40,000 ohms.

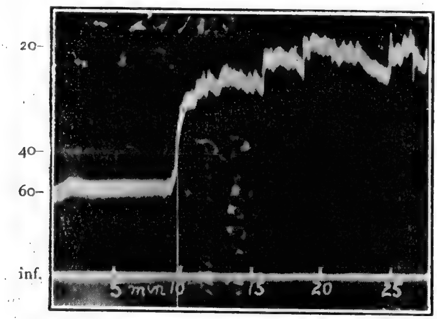


FIG. 1.—Galvanometric record of Miss G. De D. during the air raid of January 29, 1918. At the tenth minute of observation the noise of maroons, immediately followed by that of aeroplanes and guns, broke out, and the resistance, which was approximately 60,000 ohms during the first ten minutes before the disturbance, fell to approximately 20,000 ohms during the next fifteen minutes. (On the left band is given the resistance in thousands of ohms.)

From many experiments made on different subjects, besides the big variation in actual resistance there is a marked difference in emotive response; also in the change of resistance which takes place during an experiment, and in the response of the subject to the same stimulus at different stages of the experiment. In some individuals a greater physiological change may be caused by an imaginary than by a real excitation. This is especially the case in imaginative subjects, such as members of the literary, artistic, and scientific professions. A very interesting record (Fig. 1) is given of the response of a subject taken during an air raid.

Comparative records are also given of two officers, one of high and the other of normal emotivity. It would be of extreme interest to know the nature of response in a series of subjects who have successfully withstood many nerve-trying ordeals—as, for example, the response of the experienced and successful fighting air-pilot. It is possible that this test would be of value in special cases in the selection of air-pilots, and also invaluable to the military authorities as an adjunct to the ordinary medical examination in classifying doubtful "nerve" cases, *e.g.* shell-shock, neurasthenia, and malingering.

ATMOSPHERIC POLLUTION.

An examination of the third report of the Advisory Committee on Atmospheric Pollution, published as a supplement to the *Lancet* of March 23, shows that the total deposit for 1916–17 has increased in the (six) summer months over that of the previous year, which was greater than that of 1914–15, so that there has been a steady increase in most of the stations during the past three years. On the other hand, in the (six) winter months a diminution in 1916–17 is recorded. No very definite conclusions can be drawn from these results, as the stations have in some cases been changed; but in London, where the same stations have been in steady operation during this period, there is a distinct improvement in the winter months, and the same is true of Glasgow.

Among the towns exhibiting the highest deposits of atmospheric impurities St. Helens and Glasgow stand out most prominently, whilst Malvern and Exeter, as might be expected, exhibit the lowest figures.

A comparison of deposits during wet and dry weather indicates that, whereas insoluble matter is little affected by rainfall, soluble matter is brought down in much larger amount. The highest and lowest deposits, based on the average of eighteen stations, correspond, nevertheless, in no instance with the highest and lowest rainfall.

Some kind of automatic recorder for the rapid registration of atmospheric pollution, to replace the cumbersome and tedious method at present used, has always been a great desideratum. Dr. J. S. Owens describes in the present report a simple form of such an apparatus, whereby a known volume of air (2 litres) is drawn at a fixed rate through an aperture ($\frac{1}{8}$ in.) into which a piece of filter paper is inserted. The stain produced by the arrested dust particles gives a measure of the amount of suspended impurity, and by calibration with weighed quantities, which have been determined by Mr. J. G. Clark, the depth of deposit can be expressed quantitatively. The method appears to give trustworthy results, and each determination is complete in ten minutes. It does not, of course, touch the gaseous impurities, but as these run to a great extent parallel with the solid impurities, and as the latter are the more injurious, the results should give a fair record of the changes taking place in atmospheric pollution at different centres. As the method involves simple apparatus and but little attention, it is to be hoped that a larger number of observers will be induced to enrol themselves under the present committee.

J. B. C.

LUBRICATING OILS.

In a paper read by Drs. A. E. Dunstan and F. B. Thole before the Institution of Petroleum Technologists on April 16, the authors, in reviewing the work of previous observers, point out that little knowledge exists as to the chemical composition of lubricating oils and the relation between their chemical character and lubricating properties. These oils probably consist (though nothing very definite is known) of saturated and unsaturated hydrocarbons of the naphthenic or polynuclear type, and, to a limited extent, of paraffins and aromatic hydrocarbons.

The authors have made careful determinations of viscosity by a modified form of Ostwald apparatus, and discuss lubricating value in terms of this property and chemical composition. The desideratum for a lubricant appears to be low viscosity and good lubricating power, as the lubricant is concerned in the transformation of solid into liquid friction. On the other hand, the mysterious property known as "body"—that is, the power of maintaining a film (or film strength) between shaft and bearings—is a vital factor. This property of body seems to depend on surface tension, and is not necessarily dependent on viscosity, but appears to be connected with molecular weight. The possible iso-colloid nature of heavy oils in explaining high viscosity is considered, and the view is put forward that if this is the true nature of such oils, the film strength may depend upon the relation of the two phases present in the oil.

The following are some of the authors' general conclusions:—Paraffinoid oils, though highly stable, have little lubricating value, and the smaller the hydrogen content, the greater the viscosity and durability; it is the polynuclear naphthenes, especially the unsaturated components, which confer viscosity and film strength; the higher fractions of petroleum contain such unsaturated members, which, when removed, exhibit lower density, lower viscosity, higher molecular weight, and, generally, lower lubricating value.

It appears, then, that the true lubricant is an unsaturated compound possessing the characteristic attributes of such compounds, and this applies not only to hydrocarbons, but also to fatty oils, such as rape, castor, and olive oil; in other words, unsaturation is a feature of chemical activity which, in addition to colour, taste, smell, and physiological properties, manifests itself in lubricating value. Moreover, the colloidal condition of a good lubricant may also have to be taken into consideration.

The whole subject of liquid lubricants is an important one, and in the above brief summary the authors have brought forward a contribution of a highly suggestive character, which emphasises very clearly the necessity for further comprehensive and detailed study.

STATISTICAL METHODS APPLIED TO PRACTICAL PROBLEMS.

WE have received a copy of the presidential address delivered before the Indian Science Congress at Lahore in January last by Sir G. T. Walker, Director-General of Observatories, India (Calcutta: Thacker, Spink, and Co.). The bulk of the address is devoted to illustrating the application to important practical problems of statistical methods. Illustrations are given of the use of coefficients of correlation in connection with crop prediction, and also to show the extent of co-variation between the fever rate, population, cost of rice, cultivated area, and rainfall, so far as this can be determined by a first-degree regression equation computed from the data of twenty-five years.

An interesting point is the apparently close association between an increase of population and an increase of fever. Sir G. T. Walker observes that this "is so directly opposed to widely accepted medical ideas that for some months I did not treat it seriously. But on my informing Major McKendrick, of Kasauli, of it he urged me not to reject it lightly, and directed my attention to some analysis of his which would suggest an explanation. I have therefore examined the corresponding relationship for all the ten provinces of India for which sufficient data are available, and have not found a single negative coefficient. The average value is $+0{\cdot}5$. For those of you who are interested in sanitary matters I may briefly explain that the spread of malaria among men depends upon the meeting of healthy men with infected mosquitoes, and the spread among mosquitoes on the encounters between infected men and healthy mosquitoes; hence the relations are symmetrical from the mathematical, if not the æsthetic, point of view, and an increase in the number of men has essentially the same bad effect as an increase in the number of mosquitoes."

In view of the work which has been done upon the method of variate difference correlation during recent years, it would be of interest further to explore the association by the new method. Statisticians in this country will appreciate the concluding passage of Sir G. T. Walker's address:—"I hope that statistical methods may before long be recognised as essential for efficiency for the following reasons. First, a table of data covering, say, fifty years gives any intelligent man the same advantage as if he had carefully watched the conditions for fifty years and had a perfect memory; secondly, employing a draughtsman to plot these data will suggest relationships in a manner which would otherwise require profound study of the figures; and thirdly, employing a clerk to work out the correlation coefficients and regression equation will give him without effort trustworthy information about their relationships which will distinguish direct from indirect effects, and could be got in no other way."

METHODS OF GAS WARFARE.

THE issue of the Journal of the Washington Academy of Sciences for February 4 last includes a report of a lecture by Prof. S. J. M. Auld, of the British Military Mission, on "Methods of Gas Warfare," delivered before the Academy. Naturally in the lecture, which is here summarised, attention is confined to a description of what the Germans have been doing; nothing is said of the activities of the Entente Powers in this direction.

The first gas attack was made by the Germans in April, 1915, and the whole method of the war was changed. The attack was made, of course, against men who were entirely unprepared—absolutely unprotected. The Germans expected no immediate retaliation, as they had provided no protection for their own men. A clear and unobstructed gap in the lines was made, which was only closed by the Canadians, who rallied on the left and advanced, in part through the gas-cloud itself.

The method first used by the Germans is simple, but requires great preparation beforehand. A hole is dug in the bottom of the trench close underneath the parapet, and a gas cylinder is buried in the hole. It is then covered first with a quilt of moss containing potassium carbonate solution, and then with sand-bags. When the attack is to be made the sand-bags are taken off the cylinder, and each cylinder is connected with a lead pipe which is bent over the top of the parapet. A sand-bag is laid on the nozzle to prevent the back "kick" of the outrushing gas from throwing the pipe back into the trench.

The attackers must know the direction and velocity of the wind with certainty. Favourable conditions are limited practically to wind velocities between twelve and four miles an hour. A wind of more than twelve miles an hour disperses the gas-cloud very rapidly. An upward current of air is the worst foe of gas. If the trench line is very irregular it is likely that gas will flow into a portion of one's own trenches. The

Germans use a 40° angle of safety; that means that on a given straight portion of the front the wind direction must lie between the two directions which make angles of 40° with the neighbouring sections of the front. The most suitable type of country is where the ground slopes gently away from where the gas is being discharged. If the country is flat like that about Ypres, and the wind direction is right, there is little difficulty about making an attack. German gas attacks are made by two regiments of pioneers, with highly technical officers, including engineers, meteorologists, and chemists. The first attack was made with chlorine. If a gas attack is to be made with gas-clouds, the number of gases available is limited. The gas must be easily compressible, easily made in large quantities, and should be considerably heavier than air. If to this is added the necessity of its being very toxic and of low chemical reactivity, the choice is practically reduced to two gases: chlorine and phosgene. Pure chlorine did not satisfy quite all the requirements, as it is very active chemically and therefore easily absorbed.

The first protection was primitive. It consisted largely of respirators made by women in England in response to an appeal by Lord Kitchener. Then came the helmet made of a flannel bag soaked in thiosulphate and carbonate, with a mica window in it. A modified form of this device with different chemicals is still used in the British Army as a reserve protection. The outcome of attempts to counteract the effects of phosgene was a helmet saturated with sodium phenate. The concentration of gases when used in a cloud is small, and 1 to 1000 by volume is relatively very strong. The helmet easily gave protection against phosgene at a normal concentration of 1 part in 10,000.

The element of surprise came in an attack by night. The meteorological conditions are much better at night than during the day. The best two hours out of the twenty-four, when steady and downward currents exist, are the hour between sunset and dark and the hour between dawn and sunrise. Gas attacks have therefore been frequently made just in the gloaming or early morning, between lights. This took away one of the easy methods of spotting gas, that of seeing it, and we had to depend upon the hissing noises made by the escaping gas, and upon the sense of smell.

Another element of surprise was the sending out of more than one cloud in an attack. After the first cloud the men would think it was all over, but ten minutes or half an hour later there would come another cloud on exactly the same front. Efforts were also made to effect surprise by silencing the gas. But silencers reduced the rate of escape so greatly that the loss of efficiency from low concentration more than made up for the gain in suddenness. Another method was to mix the gas up with smoke, or to alternate gas and smoke, so that it would be difficult to tell where the gas began and the smoke ended.

There was a long search for materials that would absorb phosgene. The substance now used very extensively is hexamethylenetetramine (urotropine), $(CH_2)_6N_4$, which reacts very rapidly with phosgene. Used in conjunction with sodium phenate, it will protect against phosgene at a concentration of 1 : 1000 for a considerable period. An excess of sodium hydroxide is used with the sodium phenate, and a valve is provided in the helmet for the escape of exhaled air.

A high concentration for a gas-cloud is 1 part in 1000, whereas concentrations of 2 or 3 per cent. can be met by respirators depending on chemical reactivity. One such respirator is a box of chemicals connected by a flexible tube with a face-piece fitting around the contours of the face, and provided with a mouthpiece and a nosepiece. As regards the chemicals used there is no secret, for the Germans have many of the same things. Active absorbent charcoal is one of the main reliances, and is a suggestion that we owe to the Russians. Wood charcoal was used in one of their devices and was effective, but most of the Russian soldiers had no protection at all. We wanted to protect against chlorine, acids and acid-forming gases, phosgene, etc., and at one time were fearful of meeting large quantities of hydrocyanic (prussic) acid (HCN). The three things that then seemed most important were:—(1) Chlorine and phosgene; (2) prussic acid; (3) lachrymators. Charcoal and alkaline permanganate will protect against nearly everything used, even up to concentrations of 10 per cent. for short periods.

As regards the future of the gas-cloud, it may be looked upon as almost finished. The case is different with gas shells. The gas shells are the most important of all methods of using gas on the Western front, and are still in course of development. The enemy started using them soon after the first cloud attack. He began with the celebrated "tear" shells. The original tear shells contained almost pure xylyl bromide or benzyl bromide, made by brominating the higher fractions of coal-tar distillates. The German did his bromination rather badly. It should be done carefully or much dibromide is produced, which is solid and inactive. Some of the shells contained as much as 20 per cent. dibromide, enough to make the liquid pasty and inactive.

When the Germans started using highly poisonous shells, the substance used was trichloromethyl-chloroformate, but not in great strength.

The use of gas out of a projectile has a number of advantages over its use in a gas-cloud. First, it is not so dependent on the wind. Secondly, the gunners have their ordinary job of shelling, and there is no such elaborate and unwelcome organisation to put into the front trenches as is necessary for the cloud. Thirdly, the targets are picked with all the accuracy of artillery fire. Fourthly, the gas shells succeed with targets that are not accessible to high explosives or to gas-clouds.

Among the effective materials used by the Germans for gas shells were mono- and tri-chloromethyl-chloroformate. Prussic acid never appeared; the Germans rate it lower than phosgene in toxicity, and reports concerning it were obviously meant merely to produce fear and distract the provisions for protection.

During the last months of 1917 the actual materials and the tactics used by the Germans have undergone a complete change.

One substance used for the method of simultaneously harassing and seriously injuring was dichlorodiethylsulphide (mustard gas). It has a distinctive smell, rather like garlic than mustard.

Up to the present time there has been no material brought out on either side that can be depended on to go through the other fellow's respirator. The casualties are due to surprise or to lack of training in the use of masks. The mask must be put on and adjusted within six seconds, which requires a considerable amount of preliminary training, if it is to be done under field conditions.

Among other surprises on the part of the Germans were phenylcarbylamine chloride, a lachrymator, and diphenylchloroarsine, or "sneezing gas." The latter is mixed in with high-explosive shells, or with other gas shells, or with shrapnel.

As regards the future of gas shells, it should be emphasised that the "gas shell" is not necessarily a gas shell at all, but a liquid or solid shell, and it opens up the whole sphere of organic chemistry to be drawn upon for materials. The material placed inside the shell is transformed into vapour or fine droplets by the explosion, and a proper adjustment between the bursting charge and the poisonous substance is necessary. Both sides are busy trying to find something that the others have not used, and both are trying to find a "colourless, odourless, and invisible" gas that is highly poisonous. It is within the realm of possibilities that the war will be finished, literally, in the chemical laboratory.

The following compounds have been used by the Germans in gas-clouds or in shells:—

1. Allyl-*iso*-thiocyanate (allyl mustard oil), C_3H_5NCS (shell).
2. Benzyl bromide, $C_6H_5.CH_2Br$ (shell).
3. Bromo-acetone, $CH_2Br.CO.CH_3$ (hand grenades).
4. Bromated methylethyl-ketone (bromo-ketone), $CH_2Br.CO.C_2H_5$ or $CH_3.CO.CHBr.CH_3$ (shell). Dibromo-ketone, $CH_3.CO.CHBr.CH_2Br$ (shell).
5. Bromine, Br_2 (hand grenades).
6. Chloro-acetone, $CH_2Cl.CO.CH_3$ (hand grenades).
7. Chlorine, Cl_2 (cloud).
8. Chloromethyl-chloroformate (palite), $ClCOO.CH_2.Cl$ (shell).
9. Nitrotrichloromethane (chloropicrin or nitrochloroform), CCl_3NO_2 (shell).
10. Chlorosulphonic acid, $SO_3.H.Cl$ (hand grenades and "smoke pots").
11. Dichlorodiethylsulphide (mustard gas), $(CH_2Cl.CH_2)_2S$ (shell).
12. Dimethyl sulphate, $(CH_3)_2SO_4$ (hand grenades).
13. Diphenylchloro-arsine, $(C_6H_5)_2AsCl$ (shell).
14. Dichloromethyl ether, $(CH_2Cl)_2O$ (shell).
15. Methylchlorosulphonate, CH_3ClSO_3 (hand grenades).
16. Phenylcarbylamine chloride, $C_6H_5N.CCl_2$ (shell).
17. Phosgene (carbonyl chloride), $COCl_2$ (cloud and shell).
18. Sulphur trioxide, SO_3 (hand grenades and shell).
19. Trichloromethyl - chloroformate (diphosgene, superpalite), $ClCOO.CCl_3$ (shell).
20. Xylyl bromide (tolyl bromide), $CH_3.C_6H_4.CH_2Br$ (shell).

CRYSTALS OBTAINED FROM GLASS FURNACES.

MR. G. V. WILSON has studied the materials obtained from glass furnaces of the tank type making bottle glass, where, by a rupture of the tank, the glass has flowed out and has been allowed to crystallise slowly, and he described his results to the Society of Glass Technology on April 17. He finds that crystals of wollastonite form in great numbers, partly arranged in spherulitic groups of long diverging crystalline fibres, partly as separate rod-shaped crystals with well-defined faces. Tridymite occurs also in flat hexagonal plates, very thin, but showing the polarisation in sectors which is so characteristic of this mineral. He has also observed quartz as double hexagonal pryamids in places where veins of glass have eaten their way into the bricks which make the walls of the tank; and manganese augite, of purplish-brown colour, only in parts of the glass where an excess of manganese oxide has existed through imperfect mixing of the ingredients of the batch.

Fragments of limestone, probably in part magnesian, occurred in the glass, imperfectly dissolved and showing recrystallisation through contact alteration and admixture with silica and other elements of the glass. These have a granular crystalline structure except where veins of glass penetrate into them. The new minerals produced are wollastonite, augite (golden-yellow, in small prisms), melilite, and probably a silicate of lime ($3CaO,2SiO_2$).

The vault of the furnace consists of firebrick, and is covered with a fused glassy layer, from which stalactites hang down, and drops of molten matter must have been falling into the glass below. The zone of altered brick is about an inch thick, and two layers can be detected in it—an outer glassy stalactitic layer containing much corundum and a little sillimanite in a glassy matrix, and an inner white layer looking very like white porcelain to the naked eye. This inner layer is richly charged with sillimanite needles.

The external surface of glass pots also contains very well formed crystals of sillimanite, and sometimes also magnetite and corundum. The inner surface of old glass pots often shows much sillimanite embedded in clear glass, and, where the cooling has been slow, biotite and oligoclase also make their appearance.

Mr. Wilson regards as important the presence of volatile fluxes, such as soda, given off by the heated glass. These combine with the alumina and silica of the clay, forming glassy alkali-alumina-silicates which are comparatively fusible, and serve as a medium in which corundum, sillimanite, and other minerals are crystallised. The corrosion of the glass pots is due largely to the action of this alkali-alumina-silicate melt eating its way deeper and deeper into the clay.

THE CARNEGIE INSTITUTION OF WASHINGTON.

THE Year Book for 1917 of the Carnegie Institution of Washington has now reached us in its complete form. Attention has already been directed to the report of the president of the institution with which the Year Book, which was published previously separately, opens, and the opportunity provided by the receipt of the complete volume may be taken to refer to the financial records of the institution. During the year ending October 31, 1917, the total financial receipts of the institution reached 285,120*l.*; of this amount 220,100*l.* represented interest on endowment, 20,100*l.* interest on deposits in banks, and 36,000*l.* amounts derived from miscellaneous sources. The total of the yearly incomes of the institution since its foundation in 1902 amounts to 2,886,665*l.*

The income of 1917 was expended in the manner shown in the following table:—

	£
Investment in bonds	101,100
Large projects	139,160
Minor and special projects	19,500
Publications	12,600
Administration	9,800
Total	282,160

The departments of investigation to which the larger grants were made by the trustees of the institution are shown below:—

	£
Botanical research	8,686
Embryology	6,954
Experimental evolution	11,386
Geophysical laboratory	20,302
Historical research	7,090
Marine biology	3,980
Meridian astronomy	6,231
Nutrition laboratory	9,227
Publications	2,280
Solar observatory	35,509
Terrestrial magnetism	28,441
Total	140,086

The publication of twenty-five volumes was authorised during the year at a cost of 13,000*l.*

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the eighteenth annual meeting of the Court of Governors of the University in February last, a committee of twelve of its members was appointed to take into consideration the vacant Chancellorship. The committee has held three meetings, and after careful consideration will present a report to the special meeting of the Court, which has been convened for May 23, in which it will recommend that, subject to the approval of the Crown, the Rt. Hon. Lord Robert Cecil, K.C., M.P., be elected Chancellor of the University.

CAMBRIDGE.—Reports recommending changes of considerable consequence have recently been discussed by the Senate. The report of the previous examination syndicate, in which, among other proposals, the abolition of compulsory Greek and the imposition of compulsory science were recommended (NATURE, March 14, p. 37), formed the subject of an important debate, in which many prominent members of the University took part, and in which, naturally, the retention of compulsory Greek found strong advocates. In answer to the criticism, on which some stress was laid, that it was inconsistent to remove compulsory Greek and at the same time to impose compulsory science, it was pointed out by more than one speaker that science was rightly to be compared, not with Greek, but with language as a whole. Another question of considerable importance which has been discussed is a report of the council of the Senate on the length of terms. It is proposed that the Michaelmas and Lent terms should each consist of nine, and the Easter term of eight, complete weeks. This would add seventeen days in the year to the usual period of University residence. There is also a suggestion that the general degree examinations should be held so far as possible out of full term—that is to say, in the long vacation. In the discussion one of the points emphasised was that the vacations were by no means periods in which nothing was done. A large proportion of the original work which went on in the University had to be carried out in the vacations.

The question of degrees for women has again been raised by the issue of a flysheet, bearing a number of influential signatures, in which the proposal is made that as soon as the general state of affairs admits of full consideration being given to the matter, a syndicate should be appointed to report on the measures necessary for the admission of women to membership of the University. It is suggested that membership of the University should include membership of the Senate and eligibility to serve on boards and syndicates or hold any office in the University. A reply to this has been published by a number of prominent members of the University, asking members of the Senate to abstain from pledging themselves to these proposals at the present time, when so many of the younger members are absent on war service. It is further suggested as a solution which might find general acceptance that, so far as the absence of a degree is a disadvantage to women students at Cambridge, this could be obviated through the acquirement by an official body representing the women's colleges in Cambridge of power under charter in affiliation with the University to confer degrees on women students.

SIR R. ARMSTRONG-JONES has been elected Gresham professor of physic, Gresham College, London, in succession to the late Dr. F. M. Sandwith.

PROF. A. R. CUSHNY, F.R.S., has been appointed to succeed Sir T. R. Fraser as professor of materia medica and pharmacology in the University of Edinburgh.

BY the will of the late Mr. Charles Hawksley, a sum of 300*l*. is bequeathed to the Institution of Civil Engineers for scholarships or prizes and legacies to persons in his employment.

So far back as 1838 it was urged that the city of Cork, which claimed to hold a position somewhat similar to that of Edinburgh in art and letters, was entitled to be the seat of a university for the South of Ireland. This claim has never been abandoned, although when from time to time it has been advanced—as, for example, on the establishment of the Queen's University in Ireland in 1850, of the Royal University in 1884, and of the National University in 1908—the answer given has always been that neither in number of students, in buildings and equipment, nor in the public support accorded by the province of Munster was the college strong enough to justify its transformation into a university. In all these respects a great change has come over the college during the past ten years. Its students now exceed five hundred in number; its buildings, especially its scientific laboratories, have been greatly extended; its staff has doubled, and a large and well-appointed hostel has been provided. The college now claims that it is as much entitled to the enjoyment of autonomy as the University of Belfast. A strongly supported movement is on foot to obtain a charter. A pamphlet issued by the governing body affords remarkable evidence of harmonious co-operation between all sections of the people of Munster, both Catholic and Protestant. This pamphlet is interesting as showing the extreme inconvenience of the federal system. Cork is 160 miles from Dublin, where the senate of the N.U.I. meets. Much time is wasted by the representatives of Cork in travelling thither, and when they reach the senate they find themselves outvoted by the representatives of Dublin. Nor does a member of a federation obtain the degree of control of its own affairs which is essentially desirable. Recently the senate decided that under its statutes the University alone has the right to say what new chairs shall be set up in the colleges, and this decision has been upheld by the Privy Council. The pamphlet also raises the very much larger question of centralisation *versus* the encouragement of local patriotism, adopting the view which is now generally taken that college and university should be synonymous terms, the United Kingdom being divided into provinces, each with its focus of university learning and education.

THE Education No. 2 Bill is at last in Committee of the whole House. It is the subject of an unusually large number of amendments, but the Minister of Education is giving evidence of no less tact and discretion in dealing with opponents whose purpose it is to wreck the Bill, or with extremists who, because of their zeal for education, submit amendments some of which under present conditions are impossible of achievement, than he has hitherto exhibited, with such striking sincerity of conviction, in advocating the general policy of the Bill, which has secured for it so large a measure of general support. In the course of two nights' debate the first three clauses of the Bill were considered, dealing respectively with the progressive and comprehensive organisation of education, the development of education in public elementary schools, and the establishment of continuation schools. Much concern was expressed by some Members as to the possibility of clause 1 being interpreted to mean that a decided bias might be given to definite vocational instruction, but strong assurances were given to the contrary, whilst at the same time it was made clear that, so far as continued education was provided under the Bill, it was undesirable that attention should not be paid during the four years of compulsory attendance to the requirements of the vocation in which the young person was engaged and by which he was to live. With respect to free secondary education, strongly advocated by certain Members, Mr. Fisher pointed out that 67 per cent. of the children in State-aided secondary schools had already been in receipt of free instruction in the elementary schools, and that to abolish all fees in the secondary schools would mean a loss to the State of an annual revenue of 1,200,000*l.*, but he was prepared to submit a new sub-clause to clause 4 calling upon the local authorities in preparing schemes to provide means whereby no child because of poverty should be precluded from the benefits of higher education. In the organisation of advanced courses in public elementary schools, it was agreed to have regard not only to the older, but to the more intelligent children also who stay at such schools beyond the age of fourteen, and to add to clause 2 (*a*) (ii) of the Bill the words: "So much of the definition of the term 'elementary school' in section 3 of the Act of 1870 as requires that elementary education shall be the principal part of the education there given shall not apply to such courses of advanced instruction for older pupils." With these and other slight amendments clauses 1, 2, and 3 were added to the Bill. Clause 4, dealing with the consultation of authorities for the purposes of part iii. of the Education Act, 1902, was under consideration when the Committee adjourned. There are many formidable amendments yet to be considered, notably those relating to clause 10, on continued education, but the progress already made augurs well for the future course of the measure.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 2.—Sir J. J. Thomson, president, in the chair.—Dr. J. H. **Mummery**: Nerve end-cells in the dental pulp. The author has carried further his researches on the distribution of the nerves of the dental pulp. In a paper published in the Phil. Trans. for 1912, he demonstrated that the fibres from the nerve plexus in the pulp beneath the odontoblasts do not terminate at the inner margin of the dentine as described by Huber and others, but that, although they form an open plexus around the odontoblast cells, they are also distributed to the dentinal tubes and enter the dentine in company with the dentinal fibril, but make no connection with it. Recent preparations with improved methods have demonstrated that the fibres from the deep plexus in the pulp pass to definite nerve end-cells or peripheral nerve end-organs, which this method of staining has revealed at the inner margin of the odontoblasts.—H. **Onslow**: The nature of growths in colloidal silica solutions. The late Dr. Charlton Bastian claimed to have synthesised certain symmetrical bodies, resembling Torulæ and other minute organisms, from sterilised colloidal solutions which had been exposed for a long period to light. Further, he claimed that such organisms were capable of reproducing themselves. The author has repeated the experiments, using the special samples of sodium silicate reserved for and recommended by Dr. Bastian and following his directions in every detail. The greatest precautions were taken to avoid accidental contamination. The results obtained indicate that the method employed yields tubes which are absolutely sterile for all periods up to three years.

Physical Society, April 26.—Prof. C. H. Lees, president, in the chair.—J. **Guild**: Notes on the Pulfrich refractometer. The paper deals with points to be observed in the use and design of Pulfrich refractometers. A theoretical investigation of the various errors to which measurements are liable is included.—F. **Simeon**: The accuracy attainable with critical-angle refractometers. The three factors controlling the determination of a refractive index by means of a critical-angle refractometer are, so far as the prism system is concerned, (i) the angle of the prism, (ii) its refractive index, and (iii) the angle of emergence of the critical ray from the second prism face. Expressions are obtained for the variation of the required refractive index with each of these factors separately, and curves are given connecting these variations with the angle of emergence from the second prism face for various prism angles.—Prof. H. **Chatley**: Cohesion (fourth paper). The paper is the fourth of a series dealing with the subject of cohesion. The aim of the present paper is to consider the value of molecular force as indicated by Van der Waals's gas formula (particularly at the critical state where the liquid and gaseous states merge), and to relate the results to the previous inquiry.

Linnean Society, May 2.—Sir David Prain, president, in the chair.—G. M. **Thomson**: A new fresh-water shrimp (Caridina) from Fiji.—Dr. Marie **Stopes**: *Bennettites Scottii*, sp. nov., a European petrifaction with foliage. A new species of Bennettites is described, externally very like a Williamsonia "fruit" as regards both shape and size. It is, however, a young vegetative trunk, probably a "sproutling." The three main points of particular interest about it are:—(1) It is the smallest trunk of Bennettites yet known; (2) it is the first European specimen to include well-petrified young foliage; (3) it is well preserved, and elucidates some anatomical details of leaf-structure not completely known from the American specimens.—Dr. Marie **Stopes**: A survey of the biological aspect of the constitution of coal. The history of the complicated substance known as coal was narrated, from its earliest microscopical investigation in 1833 by H. T. M. Whitham, and shortly afterwards by William Hutton (1798–1860). Four special substances were particularised as building up coal, and some concluding remarks were devoted to the ecological aspect of coal in its formation in geological times.

Mathematical Society, May 9.—Prof. Hilton, vice-president, in the chair.—E. L. **Ince**: The continued fractions connected with the hypergeometric equation.—W. P. **Milne**: Determinantal systems of co-apolar triads on a cubic curve.—A. **Young**: The electromagnetic properties of coils.

PARIS.

Academy of Sciences, April 29.—M. Ed. Perrier in the chair.—J. **Boussinesq**: Calculation to the second approximation of the limiting thrust exerted on a vertical wall by a *terre-plein* with free horizontal surface.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: The influence of intravenous injections of isotonic liquids on the dilution of the blood and on the number of red-blood corpuscles which may be lost in bleeding. From experiments on dogs, the classical theory is found not to be in complete accord with fact. The immediate cause of death by bleeding is a more complex problem than has hitherto been supposed.—E. **Ariès**: The saturated vapour pressures of triatomic liquids. The formula derived in earlier communications is applied to the examination of the experimental data for carbon dioxide, sulphur dioxide, and nitrous oxide. There are some divergences between the calculated and experimental values, the causes of which are discussed.—J. **Haag**: The application of the law of Gauss to syphilis. The application of the theory of probability to 120 cases of syphilis shows that the period of incubation obeys very exactly the law of Gauss, the average duration being thirty-four days.—L. **Roy**: The problem of reflection and refraction by plane periodic waves.—F. B. **de Lenaizan**: The resistance of the electric spark.—P. L. **Mercanton**: The magnetic state of some prehistoric pottery. The articles examined were taken from Swiss lakes (Bienne, Zurich, Pfäffiken), and from magnetic observations on nine pieces the conclusion is drawn that at the time and place of manufacture the terrestrial magnetic inclination was nearly zero.—P. **Chevenard**: The determination of the velocities of cooling necessary for the realisation of tempering in carbon steels. The results for a series of steels with carbon graded from 0·2 per cent. to 0·8 per cent. are given in the form of curves.—C. **Matignon** and F. **Meyer**: The double sulphate of soda and ammonia. Thermochemical and solubility data.—P. **de Sousa**: The epirogenic movements during the Quaternary at Algarve, Portugal.—E. **Hernandez-Pacheco**: The Archæocyatidæ of the Sierra de Cordoba (Spain).—A. **Guébhard**: Remarks on the sedimentary crust.—E. **Saillard**: The balance of some constituent principles of the sugar-beet during the manufacture of sugar. The various products arising during the extraction of sugar from the sugar-beet have been analysed, and the data used to construct balance-sheets for the dry material, nitrogen, potash, soda, and phosphoric acid. The three last-named substances can be practically all recovered and returned to the soil, but about one-half of the nitrogen cannot be utilised.—L. **Devillers**: The determination of the indigestible residue *in vitro* produced by pancreatin acting upon wheat or the products of milling and baking. Figures are given for fourteen samples of wheat, flour, and bread.—F. **Guitel**: The first stages of the development of the adhesive apparatus of Lepadogaster.—A. **Nanta**: The initial alterations of the liver in great traumatisms.

BOOKS RECEIVED.

The Third and Fourth Generation: An Introduction to Heredity. By E. R. Downing. Pp. xi+164. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1 dollar net.

Plant Products and Chemical Fertilizers. By S. H. Collins. Pp. xvi+236. (London: Baillière, Tindall, and Cox.) 7*s*. 6*d*. net.

The Alkali Industry. By J. R. Partington. Pp. xvi+304. (London: Baillière, Tindall, and Cox.) 7*s*. 6*d*. net.

University of Chicago. Publications of the Members of the University, 1902–1916. Pp. x+518. (Chicago: University of Chicago Press; London: Cambridge University Press.)

Bibliography of the Geology and Eruptive Phenomena of the More Important Volcanoes of Southern Italy. Compiled, with the assistance of Madame A. Johnston-Lavis, by Dr. H. J. Johnston-Lavis. Second edition. Pp. xxiv+374. (London: University of London Press, Ltd.)

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part xv. (London: W. Wesley and Son.) 3*s*. 3*d*. net.

The *Athenaeum* Subject Index to Periodicals, 1916. Science and Technology, including Hygiene and Sport. Pp. 162. (London: The *Athenaeum*.) 10*s*. net.

A Handbook on Antiseptics. By Drs. H. D. Dakin and E. K. Dunham. Pp. ix+129. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7*s*. net.

The Botany of Iceland. Edited by Drs. L. K. Rosenvinge and E. Warming. Part ii. Pp. 347 to 675. (Copenhagen: J. Frimodt; London: J. Wheldon and Co.) 5*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 16.

ROYAL SOCIETY, at 4.30.—Note on Certain Coloured Interference Bands and the Colours of Tempered Steel: **A. Mallock.—General Factors in Mental Measurements: J. C. M. Garnett.—The Absorption of X-Rays in Copper and Aluminium: C. M. Williams.—The Electrical Resolution and Broadening of Helium Lines: Dr. T. R. Merton.**

ROYAL INSTITUTION, at 3.—**The Prosecution and Punishment of Animals: Sir J. G. Frazer.**

ROYAL SOCIETY OF ARTS, at 4.30.—**The Freedom of the Sea: John Leyland.**

INSTITUTION OF MINING AND METALLURGY, at 5.30.

FRIDAY, MAY 17.

ROYAL INSTITUTION, at 5.30.—**The Story of a Grass: Dr. A. B. Rendle.**

TUESDAY, MAY 21.

ROYAL INSTITUTION, at 3.—A Master of Method—Pitt-Rivers: **Prof. A. Keith.**

THURSDAY, MAY 23.

ROYAL INSTITUTION, at 3.—**The Abode of Snow; Its Appearance, Inhabitants, and History: Sir Francis Younghusband.**

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—**Some Transient Phenomena in Electrical Supply Systems: Prof. E. W. Marchant.**

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 5.30.—**Internal Ballistics: Lt.-Col. A. G. Hadcock.**

LINNEAN SOCIETY, at 3.—**Anniversary Meeting.**

SATURDAY, MAY 25.

ROYAL INSTITUTION, at 3.—**Problems in Bird-Migration: Prof. C. J. Patten.**

TUESDAY, MAY 28.

ZOOLOGICAL SOCIETY, at 5.30.—**A Case of Hermaphroditism in a Lizard, *Lacerta viridis*: Noel Taylor.—Fresh-water Fish as Food: C. Tate Regan.**

CONTENTS.

PAGE

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, MAY 23, 1918.

MONTESSORI EDUCATIONAL METHODS.

The Advanced Montessori Method: Scientific Pedagogy as Applied to the Education of Children from Seven to Eleven Years. By Maria Montessori. I., *Spontaneous Activity in Education.* Translated from the Italian by F. Simmonds and L. Hutchinson. Pp. vii+357. II., *The Montessori Elementary Material.* Translated from the Italian by A. Livingston. Pp. xviii+455. (London: W. Heinemann, 1918.) Price 8*s*. 6*d*. net and 12*s*. 6*d*. net respectively.

WHATEVER one may think of the fundamental doctrines of Dr. Montessori, her books are always eminently readable. She has a fine enthusiasm for her subject, and a rare fund of anecdotal or biographical illustrations, which are skilfully chosen for the purpose of carrying conviction. An uncritical mind is not censorious about matters of proof. An analogy is as good as a demonstration, and the freedom with which Dr. Montessori relies on analogy reminds one of a famous seventeenth-century educational reformer, Comenius. Of course, her analogies are less crude, but much of her theory and practice rests on an assumed analogy between the mature mind of the adult and the mind of the child. This assumption leads her to the conclusion that since the mature mind does its work in an orderly, logical way, applying to the world around its mechanism of categories which reduces that world to a formal order, so our first business should be to establish definite sensory categories in the mind of the child which shall make the perceptual analysis of his environment orderly and accurate. "It is the qualities of the objects, not the objects themselves, which are important"; so we must train the senses in the accurate discrimination of sensory qualities. This is the object of the didactic materials designed for the use of children from three to six years of age.

Dr. Montessori has little respect for experimental psychology; yet it is worth while noting that Stern's researches showed that children were apparently not natively interested in the qualities of objects until they were past the age of thirteen, and further researches have shown that although children might be trained to observe pictures and the like with special regard to such qualities, when left alone they quickly slip back into what seems to be the natural order of the development of interest—objects as such first of all, then things that are happening, then the spatial and causal relations of objects, and latest of all their qualities.

Unfortunately, Dr. Montessori never gives the evidence on which her conclusions are based. A pretty story does not establish a principle. This defect in her books is the more noteworthy because she has presumably had a scientific training and because she explicitly claims that her results are arrived at by exact methods. A chapter headed rather naïvely "My Contributions to Experimental Science" would surely make any person acquainted with rigorous scientific method smile. As a summary of results for popular consumption, it is not without merit, but one seeks in vain for references to the original memoirs in which the detailed work is carefully described and where the conclusions are adequately discussed. She is so acute a critic of the work of others that we might at least expect her to take as much pains as they have done to make her whole method of investigation and its detailed results accessible to scientific criticism. Popular books are necessary, but they must rest upon a solid basis of carefully recorded fact if they are to stand the test of time.

Apart from this grave defect in the Montessori literature, judged from the point of view of a scientific pedagogy, there is so much humanity in it that we must do homage to its distinguished author for her service to the cause of humane education. She enjoys flogging a dead horse (or should we say a dying horse?), apparently believing that it is still in vigorous life. She is so wrapt up in her own work that she is unaware of the great changes which the biological conception of education was bringing about in our schools before we had heard her name. But a remarkable business talent has obtained for her a hearing such as few educational writers in English-speaking countries enjoy. Where one person has heard the name of Dewey, a thousand have heard that of Montessori, and we may rejoice to think of the numbers who will read the chapters in this book on the will and the intelligence.

It is in the second volume that the application of the Montessori method to the primary school is described. There is much suggestive matter in its chapters, though very little that is new, except perhaps the "didactic materials." The author believes that teachers should be supplied with the material necessary to enable the children of themselves to achieve a desired result. This material should have been determined experimentally, and, once it has been designed, the teacher has only to make himself thoroughly familiar with its use. So we find the words and sentences for the grammar work are provided. They are carefully graduated and laid out in neat boxes. One is irresistibly reminded of Pestalozzi's ambitious designs. Get the mechanism right and train your teachers in the use of it, then all will be well. Of course, the mechanism is the result of experimental inquiry, as was Pestalozzi's, but, in spite of the charm with which it is described, we fear it will share the same fate as Froebel's gifts and Pestalozzi's A B C's.

Rather more than a third of the volume is given to grammar. Under the stimulus of the apparatus, children of eleven are led to distinguish eight kinds of adverbs and fourteen kinds of conjunctions, but the apparatus for arithmetic only carries them to a stage which a good Standard III. child in an English school would find easy. The rest of the book deals with geometry, music, rhythm, and verse structure. The range of the last may be gathered from its concluding paragraph, which tells us that "the child is now ready for the more difficult problems of anacrusis, catalexis, irregular feet, and irregular pauses." There is nothing of history or geography in the book. No doubt the didactic materials are still in preparation.

J. A. G.

MODERN INDUSTRY.

(1) *What Industry Owes to Chemical Science.* By R. B. Pilcher and F. Butler-Jones. With an introduction by Sir G. Beilby. Pp. xiv+150. (London: Constable and Co., Ltd., 1918.) Price 3*s*. net.

(2) *Some Problems of Modern Industry: Being the Watt University Lecture for* 1918. By W. C. Hichens. Pp. 61. (London: Nisbet and Co., Ltd., 1918.) Price 6*d*. net.

(1) IF British trade is to hold its own in face of the acute competition which is to be expected, great alterations must be effected, and these two books point out some directions in which improvements may be made. Messrs. Pilcher and Butler-Jones's handbook is a capital *résumé* of the improvements made in metallurgy and in the manufacture of dyes, explosives, glass, pottery, and many other commodities by the application of scientific research. It is very readable, and gives in a handy form an accurate and interesting account of the growth and results of industrial chemistry. It shows how much we owe to British and French chemists, and avoids a common mistake which gives the main credit in this matter to Germany. It is the most compact and convenient history of industrial chemistry which we have come across. As a rule, the authors have kept to general principles, and this is wise, because the book is not intended for experts in each particular trade, but for the public as a whole, and because no one or two men can write on the various industries concerned with first-hand knowledge of all, but must depend on other books for a large part of the information.

In some cases, where the authors have gone into detail—for example, in describing the Pattinson and Parkes processes for lead refining—the details show that the authors have no recent actual experience of the methods employed in this country, but have probably relied on text-books. In dealing with monazite sand the large and rich deposits in the south of India might be mentioned, and the successful diversion of these sources from German hands to our own. In relation to the competition between artificial and natural indigo the recent action of the Indian Government in applying modern scientific methods to the production and marketing of natural indigo should be recognised. Would that all Governments and Government Departments were equally broad-minded and far-seeing! In this country the permanent Government officials are usually recruited from a class which, though aware of the importance of chemistry, is so out of touch with chemists, and so lacking in sympathy with chemical ideas, that it is hard for them to realise what is really required by the country. The average Member of Parliament and the average man of business do not recognise that a first-class man of science is, as a rule, valuable only in his own subject. Messrs. Pilcher and Butler-Jones's book will show the public at large how enormous the science has become, and how stupid it is to expect an electrician to be an authority on paraffin oils, or a genius in spectroscopic work on gases to be a sound guide in the manufacture of artificial rubber.

(2) As chairman of Cammell, Laird, and Co., Mr. Hichens is able to look at modern industry in a broad manner. He deals mainly with ethical questions, the relations with labour, conditions of work, the right of the State to a share in profits, and so on. He has a pleasant style of writing, and his commercial training has not destroyed his power of refreshing his mind and the minds of his audience by recalling some picture of a bygone age before trade-unions or excess profits were thought of. It is impossible in an hour's lecture to do more than indicate the sort of problem to be tackled. Mr. Hichens has done this in an agreeable and interesting manner, and his lecture should appeal to all students of social problems.

BALLISTICS.

Text-book of Ordnance and Gunnery. By Lt.-Col. W. H. Tschappat. Pp. x+705. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 30*s*. net.

AT no previous time in history has so much attention been paid to artillery as during the present war. The unprecedented number and variety of guns in use enable a mass of evidence, sufficient to prove or disprove any theory which is considered worthy of a practical trial, to be accumulated in a very short space of time. Moreover, it is almost certain that all the belligerent countries are liberally spending money on researches into the various branches of the art of gunnery, and employing, for this purpose, more men of scientific reputation and mechanical genius than have ever considered the subject seriously before. As a natural consequence, "ordnance and gunnery" must be in a state of rapid development, and it would therefore appear to be a somewhat unfortunate moment for the publication of Col. Tschappat's book, which is, so largely, merely a revision of an excellent book with the same title by Lt.-Col. Lissak.

That the revision has effected a decided improvement cannot be denied, but there is little that is new, of any importance, to be found in it. The major alteration is in the treatment of interior ballistics. Col. Lissak used Ingall's method. In the volume under review a carefully elaborated method of producing the pressure and velocity curves by integrating the energy equations is presented. The method has the advantage that a complete calculation of a gun can be made without any firing data, but the process seems laborious, and there does not seem to be any means provided for quickly finding the point of maximum pressure. This must lead to considerable labour when finding the best relation between the capacities of chamber and bore for a new type of gun.

Other additions to Col. Lissak's text are: descriptions of the manufacture of the American nitrocellulose powder; the modern hydro-pneumatic recoil systems; the 12-in. mortar carriage, model 1908; and the Lewis air-cooled machine-gun. Otherwise Col. Lissak's text has been largely adhered to, but the subjects have been rearranged in a more logical sequence.

The chapter on interior ballistics is marred by the number of errors in the formulæ which have escaped notice.

OUR BOOKSHELF.

Equipment for the Farm and the Farmstead. By Prof. H. C. Ramsower. Pp. xii+523. (Boston, Mass.; London, etc.: Ginn and Co., 1917.) Price 10*s*. 6*d*. net.

IN this volume Prof. Ramsower has broken new ground and given us an account of the equipment necessary for starting and maintaining a farm in the United States, with special reference to the conditions in the Middle West. About half of the book deals with the construction of the farmhouse and buildings, and the other half with farm implements. As material for construction about the farm, Prof. Ramsower recognises the great advantage of concrete, though he also realises its disadvantages. There is an interesting chapter on the lighting of the farmhouse. Water supply and sewage are also dealt with at length, and considerable stress is laid on the need for adequate sanitation.

The remainder of the book deals with farm implements. The plough comes first as the basal tillage tool, "walking" ploughs and "sulky" ploughs being both described. The former is the type commonly seen in this country when the ploughman has to walk; the "sulky" plough, on the other hand, allows him to ride; it takes its name from the light two-wheeled carriage used in America, and is called a "sulky" because it accommodates only one. The difference between them lies in the amount of friction; the ordinary plough rests on a smooth slade or sole, which slips over the ground; the "sulky" plough, on the other hand, rests on wheels. Thus, the sliding friction of the ordinary plough is replaced by rolling friction, and, in consequence, it is possible to add the weight of the frame and the driver without materially damaging the draft of the plough.

Harrows are dealt with at length: the spike-tooth forms, as commonly seen here, and the spring-tine and the disc forms, which seem to have great possibilities. There is also a useful chapter on the gasolene and oil engine, in which the author describes not only the engines themselves, but also some of the many troubles which arise directly an engine or tractor is set to work on a farm.

The book is well illustrated, and will be found very helpful to serious farm students.

Everyday Physics: A Laboratory Manual. By J. C. Packard. Pp. vi+136. (Boston, Mass.; London, etc.: Ginn and Co., 1917.) Price 4*s*. 6*d*. net.

A LABORATORY manual outlining a course in physics "adapted equally well to preparation for college and to the immediate requirements of everyday life" may be regarded as a sign of the times. It is becoming recognised in an increasing degree that the fundamental principles of physical science must be employed not only in the laboratory, but also in the home and in the factory. Mr. Packard, who is science master at the High School, Brookline, Massachusetts, has produced a volume of considerable interest and originality, which may be recommended to teachers who are planning a practical course in science for a secondary school. More than sixty exercises are given, covering a wide range of subjects, the usual experiments in a physics course being combined with newer exercises involving the use of commercial apparatus. Thus we have not only a "Study of a Metric Rule," but also a "Study of a Water Meter," with instructions for testing the accuracy of the meter by filling a tank of which the dimensions are to be determined. This is followed by exercises on gas and electricity meters with clearly drawn diagrams for each case.

A few of the more novel subjects studied include a water motor, a life preserver (illustrating the principle of Archimedes), an anemometer, a gas or alcohol stove, methods of domestic heating, lighting, and ventilation, the mechanism and action of a clock and of a sewing machine. Nearly every exercise is preceded by an introduction, intended to show the bearing of the topic in hand upon related subjects, and is followed by questions or problems emphasising the immediate application of the principle involved to the affairs of daily life. Topics for further study and investigation are suggested, and the author points out that much valuable material for every department of science can be gathered from trade catalogues. The student is instructed as to the best method of recording the results of his observations, but, as the author rightly says, the object of a laboratory course in physics is not to make a note-book, but to teach the principles of physics and to emphasise their practical application.

H. S. A.

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 Supposed "Fascination" of Birds by Snakes.

I HAVE now received a reply from Capt. G. D. H. Carpenter to my letter suggesting that he had observed an instance of "mobbing." It was written in January last from Lulanguru, seventeen miles east of Tabora, in ex-German East Africa:—

"Regarding my snake and bird observation, the birds' behaviour was quite unmistakable; they were not looking for food or anything else, and did literally appear to be 'scared stiff,' as one might say. If it was mobbing, it was very different from such active mobbing as I have seen—one might call it 'passive mobbing,' for there was no attempt at offence either by word or deed. The feeble chirps sounded more like a faint protest than anything else."

It must be remembered, as Mr. S. A. Neave has pointed out to me, that in such cases the presence of numbers is in itself disconcerting, however feeble may be the powers of the mobbers. Capt. Carpenter's description suggests that the snake was disturbed and harassed.

I was mistaken in supposing that Mr. F. Muir's observation (quoted in NATURE of January 17, p. 385) was made in East Africa. He informs me that it was in Amboyna in the latter part of 1907 or early in 1908. Mr. Muir writes:—

"Is it not possible that birds are paralysed with fear rather than 'fascinated' in such cases? I had a parrot in Africa (now living at Brockenhurst with Dr. Sharp's family) which would fall off her perch if a dead or living snake was brought near to her; even a piece of rope suddenly brought into view would produce a fright which would paralyse her and prevent her even from screaming."

I have just received the following interesting record of observations by Mr. C. F. M. Swynnerton, writing from Chirinda, South-East Rhodesia:—

"March 29, 1918.

"For more than a year past I have lived in a house in an open space, but our old house was closely surrounded by trees, and, in the breeding season particularly, the mobbing of tree-snakes by birds was often, for a week or ten days together, a daily occurrence.

"Birds probably mob tree-snakes whenever they detect them, for I have seen such mobbings both out of the breeding season and when I was unable by a careful search to find a nest; but in most cases where a nest was concerned the birds—most commonly bulbuls in my observations—that were the parents of the fledglings were the first to detect the snake's approach to the nest and to start the hue and cry. Shrikes, sunbirds, flycatchers, warblers—in fact, any bird that happened to be near—would quickly join in and mob the snake, scolding all round it and occasionally darting in at it in the very manner in which they mob an owl. The mobbers remain, for the most part, out of striking distance of the snake, but some—and this applies especially, in my observations, to the 'puff-back shrike' (*Dryoscopus cubla*)—are very bold, both in the matter of darting in and in staying near the snake. A bird perched in front of the snake, as I have sometimes seen it, with its wings drooping and quivering with excitement, might well be taken by an ignorant person, who did not follow his observations up, to be fascinated by it; whereas it is, in reality, busy hurling at the snake every unpleasant name it can lay its tongue to. The mobbing sometimes continues for half an hour, sometimes for much longer, though the individual mobbers do not always—with the exception of the owners of the threatened nest—remain the same. Some tire and go off—anyway, temporarily—and their places are taken by others. The snake in general appears to take little notice of the birds, though it will commonly face a specially bold one; and I have seen it lunge sometimes, but unsuccessfully. Were it to succeed, I suppose the believer in fascination would be confirmed in his belief. Probably, too, even when apparently indifferent, it is sometimes embarrassed and delayed, for it will sometimes stay quite still for long together—except for the constant flickering of the tongue. When it reaches the nest there is a great scene on the part of the parents, and they lose any fear of the snake they may have had before in their attempts to save their young. The latter, if nearly fledged, generally take fright as the result of their parents' actions, and not (as I have proved experimentally) from any instinctive fear of the snake, and flutter down. I have seen little bulbuls come down thus unharmed from a nest 50 ft. up. Mostly I have shot the snakes before they have reached the nest, but I have seen young birds taken, and I have also taken them from inside snakes that had left a nest or were coiled about it. The snake in nearly every case has been *Disphoridus typus*, I believe, for I do not remember if I have actually taken it to Mr. Boulenger.

"For two or three seasons I watched all the mobbings I could, as I had noticed in the case of birds of which I knew the courting display that this tended to be repeated under the excitement of mobbing, and I felt that the converse would also be true. So I watched in order to get the displays of the different species. I obtained in this way a certain number of notes, but these do not bear on your question, referring, I believe, solely to this matter of display. The watching of these mobbings of snakes—which I supposed were well known—long ago convinced me that there was nothing at all in the 'fascination' idea. The birds show great daring and insolence, and it is hatred and indignation, and perhaps partly the desire to assist, and not 'fascination,' that draws them to the snake. It is the same, I believe, in the case of hawks and owls—for the birds will certainly recognise the latter as an enemy, apart from its rough resemblance to a hawk. I have taken a freshly eaten bird from an owl's stomach (*Syrnium woodfordi*) when it was barely twilight and small birds were still active." EDWARD B. POULTON.

Oxford, May 6.

As I was correcting the proofs of the above, the following letter from Capt. Carpenter reached me. The behaviour observed by him is, I believe, to be interpreted as due to the interplay between two opposing impulses, both beneficial—one based on the fear of snakes, the other on social stimuli which incite to combination for the purpose of harassing an enemy. It is only to be expected that such interplay will lead to different behaviour with different species of bird, and perhaps with the same species in the presence of different types of snake. Differences are, above all, caused, as Mr. Swynnerton shows, by the behaviour of the snake, which, when it attacks the nest, brings in a third impulse—the defence of offspring—and leads the parent birds to act as though they were altogether without fear. E. B. P.

May 13.

"I have only recently received the copy of NATURE for November 29, 1917, in which you printed Prof. Poulton's letter commenting on an observation of mine on the subject of 'fascination' of birds by snakes. Prof. Poulton suggested that this was a case of 'mobbing,' and has just sent me a proof of his second communication on this subject, giving instances of 'mobbing' noted by field naturalists.

"I wish to direct attention to the following point:—The mobbing of a snake or a bird of prey is most definitely a *voluntary* act on the part of the small birds.

"In the case which I described, however, the behaviour of the little finches strongly suggested that they were there *against* their will, or perhaps one should say their better judgment.

"The 'faint chirps' which I described were not the sounds uttered by angry birds, but like those that might be made as a feeble protest against some overpowering influence; and the whole behaviour of the birds was utterly unlike that of a crowd deliberately mobbing a bird of prey with angry noises. I have witnessed this on several occasions, but have not seen a similar demonstration against a snake.

"I would ask readers to note, in the professor's second letter, the difference in the behaviour of the birds from that which I have described.

"Mr. Kershaw speaks of 'a great hubbub'; Mr. Hockin of the birds as 'shrieking for all they were worth.' This is surely something of a very different order from the 'faint chirps' of apparently unwilling birds which I heard. Indeed, they at once reminded me of the nightmare in which one attempts to cry out and run away, and can do neither!

"I still believe that it was a case of 'fascination,' although I do not for an instant imply that it was by some mysterious power emanating from the snake.

"May it not be analogous to the strange fascination which the morbid and terrible have for some human beings?

"There are individuals who have a horror of going near to the top of a precipice, for they feel as if they must throw themselves over, yet at the same time they feel constrained to go and look at the chasm which 'fascinates' them. G. H. HALE CARPENTER.

"c/o Medical G.H.Q., Dar es Salaam,
March 12."

SCIENTIFIC TESTS FOR THE SELECTION OF PILOTS FOR THE AIR FORCE.

MODERN aviation by its complex evolutions in a rarefied atmosphere imposes an enormous strain upon the bodily mechanisms. It is important, therefore, that the subjects selected for such work shall be in every way fitted for it, otherwise early breakdown or worse may result to the would-be pilot, in addition to needless expense to the country. The problem of the selection of fit candidates is therefore best approached from the point of view of practical aeronautics.

Considering the effects of a flight in detail, with increasing altitude there is in the first place a deepening of the respiration necessary to secure an adequate oxygen supply. Later, the pulse quickens, and, since a quickened rate of heart-beat entails increased oxygen consumption, there is established a vicious circle—namely, an increased oxygen consumption with a progressively diminishing supply. Therefore, all the bodily devices that render the respiration and the circulation efficient will be called into play—in particular the nervous mechanisms controlling the respiration and circulation. Finally, at great altitudes loss of muscular power and nervous symptoms, subjective and objective, supervene, so that the pilot or observer finds it difficult to perform his work efficiently.

In addition to the effects of altitude, there is, as regards the nervous system, the psychical strain involved during preliminary training, the anxiety of the first solo flights, and, finally, the stress of combatant service. For these reasons it is evident that the candidates for aviation must be of the fittest. As is to be expected, therefore, past experience has shown that candidates with a good physique and previous excellence at sports make the best pilots.

Considering the examination of candidates in more detail, it is important first of all that the candidate shall be able to withstand the effects of work in a rarefied atmosphere. No matter how sound in body and limb, a candidate for the Air Force is useless if he will not wear well under these conditions. From this point of view it is to be borne in mind that previous knowledge of mountain sickness and life at high altitudes is of little service, as there is no evidence of any acclimatisation to altitude in the flying officer.

At the Aviation Candidates' Board particular attention is devoted to the respiratory system, where, in addition to good, healthy lungs and an efficient vital capacity, it is deemed necessary for the candidate to be able to hold the breath for a considerable period of time. In regard to the last test, it has been shown by careful correlation with more complex tests that the power to hold the breath is closely related to the capacity of the candidate to bear the strain of high altitudes.

In addition to an organically sound heart, it is also deemed essential by this Board that the heart shall respond efficiently to work both in respect of increase of pulse-rate and time of return to the normal. This is tested by getting the candidate to step from the ground on to a chair five times in fifteen seconds. The increase in pulse-rate is noted, and the time of return to the rate before the exercise carefully observed. The standards for this test have been set by the examination of a number of successful pilots.

As regards the circulatory standard, it is held that the difference between the pressure in the circulatory system when the heart is beating and the pressure when the heart is resting shall not be great (more than 50 mm. Hg), nor the latter pressure (the diastolic pressure) too low (below 70 mm. Hg).

In regard to the nervous system, besides signs of good nervous stability, it is deemed important that the candidate shall have accurate vision; and examination is particularly directed to rule out cases of concealed hypermetropia, which involves bad landing. A good colour sense is also necessary.

In Allied countries especial attention has been directed to the examination of the labyrinthine mechanism. Although practised, such tests have not so great a vogue in this country. It is to be remarked that, as carried out by means of the revolving chair, the labyrinthine tests yield information in regard to the horizontal canals, whereas in most aerial "stunts" it is the superior canal which is important to the airman. Therefore, if tests for this mechanism be employed in great detail, they should also be directed to the investigation of the superior canal.

A further criticism of these tests is that they are based largely on theoretical considerations, and before standards are adopted in regard to such it is important that a series of healthy and successful pilots should be examined. Since aviators may emerge from a cloud "on their backs" (that is, with the machine upside down), it is still a matter of contention as to the absolute degree of efficiency which is required in regard to the labyrinthine mechanism.

On the other hand, in regard to the aural examination, it is beyond doubt that the candidate must have good hearing, if only to detect the noise of defective working of his machine, and also healthy tympanic membranes and uncongested Eustachian tubes, so that he may readily adapt himself to varying changes of pressure.

Good muscular sense is of great importance in a candidate, since there is reason to believe that normally this plays intuitively a considerable part in the accurate balance of a pilot and his machine. Particular attention, therefore, is directed to this point at the British Aviation Candidates' Board.

In regard to reaction times these have been fully investigated by the French authorities, but with the present large demand for candidates for the Air Force it is impossible and unnecessary to carry out such tests in great detail, since during his training this is done to a certain extent by his instructor, and the candidate eventually allotted to the type of machine for which, in this respect, he is found most suitable. This, however, does not mean that such tests should not be applied in special cases.

The flying temperament, it must be confessed, rather baffles assessment, and at the present time it is difficult to eliminate the candidate who may develop an "anxiety neurosis," and therefore later become unsuitable for flying.

Valuable information is obtained from previous medical history, and, to a certain extent, from family history; it is deemed inadvisable, as a general rule, to accept any candidate who has a previous history of serious respiratory trouble or nervous breakdown of any kind. In regard to a history of concussion, however, it has been found that 40 per cent. of successful pilots give a history of concussion of varying duration. Therefore, if at the time of examination there are no signs of nervous instability, it shows that the candidate has a nervous system which can recover well from the effects of concussion. Also the history of the accident leading to such concussion frequently reveals a degree of enthusiastic recklessness characteristic of the "flying" temperament, and for this reason the subject is likely to make a good pilot.

MARTIN FLACK.

THE ZINC ORE RESOURCES OF THE EMPIRE.

THE Mineral Resources Committee of the Imperial Institute has arranged for the publication of a series of monographs on the mineral resources of the Empire, of which the first, dealing with zinc ores, is now issued. Copies of this monograph are obtainable at 2s. each, post free, from the Imperial Institute.

Mr. S. J. Johnstone has been chiefly responsible for the work of compilation, and Mr. T. Cook for that of general revision. They have been assisted by Mr. W. S. Robinson, vice-president of the Australian Metal Exchange, and a member of the Imperial Institute Committee for Australia.

In issuing these monographs, the aim of the committee is stated to be not so much to cater for the specialist as to diffuse knowledge of the Empire's mineral resources among those who control and sell them and those who use the products to which they give rise, in the hope that the dissemination of such information will lead to a greater utilisation of these resources within the Empire itself than has been the case in the past.

Although large quantities of zinc ore were mined in the Empire before the war, nearly all the product was exported to and smelted in Germany and Belgium. Thus in 1913, although the Empire produced 20 per cent. of the world's output of zinc ores, its total production of the metal (spelter) was only 6·4 per cent. of the world's output, and not quite half of this was primary or virgin spelter, the remainder being secondary (remelted) metal. Germany and Belgium, on the other hand, produced about 48 per cent. of the world's annual supply of spelter, although they themselves contributed only 23 per cent. of the world's output of zinc ore, the rest of their supplies being obtained from the famous Broken Hill concentrates shipped from Australia.

In the last pre-war year Germany led the way in ore-production, followed by New South Wales, the United States of America, Spain, and Italy, in order of magnitude. These are the principal ore-producing countries.

The most important ore-minerals of zinc are the sulphide, ZnS, known as zincblende and also as sphalerite, and the carbonate, $ZnCO_3$, known as calamine and sometimes also as Smithsonite; the former is by far the more important source of the metal. Special mention should also be made of Franklinite, a mangano-ferrate of iron, manganese, and zinc, found in large quantities in New Jersey, U.S.A., which is a source not only of zinc, but also of ferromanganese. The silicate ore, hemimorphite, $3ZnOSiO_2 + H_2O$, also serves as one of the minor sources of the metal.

Zinc ores occur, and have been mined for some time, in many parts of the United Kingdom; of these a considerable proportion were *exported* before the war to the Continent for smelting. On the other hand, ores from foreign countries have, at the same time, been *imported* and smelted here, a condition of things which would be incredible if it were not true.

The most considerable source of zinc ore in the Empire is the deposit in the Broken Hill district, New South Wales, which is situated at the southern extremity of the Barrier range. The extreme length of the ore-bearing ridge is about two miles, and the report gives information as to how the ore changes in passing from the oxidised outcrop to the unaltered sulphide minerals below.

Stated very briefly, this monograph gives, in the first place, a short statistical account of the world's production of zinc ores and zinc, and describes the ore-minerals; then follows a section devoted to the principal ore-deposits of the Empire, special attention being given to Australia, the United Kingdom, Canada, and India, which are the principal British sources of supply; next come references to the more important deposits in foreign countries; then follow sections dealing with the valuation, concentration, and smelting of the ores, the various types of the commercial metal (spelter), with references to impurities, grades, and prices; the final section deals with the properties and utilisation of the metal, whether as such, in the form of alloys, or pigments.

There is an obvious misprint on p. 54 where it is stated that the distillation retorts are "about 8 ft. in diameter." *For* "feet" *read* "inches."

THE DECLINE IN THE BIRTH-RATE.

IN a judicial way Dr. Millard discusses, in the paper before us,[1] the problem of the fall of the birth-rate in its relation to social welfare. He does not share the orthodox view that the decline of the birth-rate is in itself a deplorable fact, or that deliberate birth-control is necessarily to be regarded with disapprobation. On the contrary, he advances substantial arguments in support of the following conclusions. The fall in the birth-rate is a general phenomenon among civilised nations. It is due, not to diminished natural fertility, but to deliberate birth-control. It is not in itself an evidence of national decadence; it may be an expression of advancing civilisation—of a more conscious control of life. Birth-control is the civilised substitute for those natural checks to the rapid growth of population—scarcity, disease, and war—which have always operated in the past. Rapidly growing populations in countries with circumscribed territories are apt to give rise to political unrest and to serve as provocatives to war. International competition in birth-rates is correlated with a competition in armaments, and both are undesirable.

The prosperity of Britain is at present wrapped up with the abundant supply of cheap coal, and the more rapidly the population of this country increases, the sooner will the beginning of the end of our coal-fields manifest itself. To postpone the approach of what the author calls the dark and gloomy epoch (who knows what other stores of energy may not be tapped before the coal is exhausted?), an increased birth-control may usefully operate. But there are more immediate reasons for advocating birth-control. It is far from being race-suicide; it is a natural ally of the maternity and child welfare movement. A low birth-rate is closely correlated with a low rate of infantile mortality. A high birth-rate usually means great infantile mortality. "Birth-control is an essential factor in the campaign against poverty. It is calculated to reduce the supply of unskilled labour, to increase efficiency, to raise wages, and to encourage a higher standard of life." It seems almost as sure a panacea as Prohibition!

1 "Population and Birth-Control." Presidential address to the Leicester Literary and Philosophical Society, 1917. By Dr. C. Killick Millard. Pp. 48. (Leicester, 1917.) Price 1s.

We think, indeed, that Dr. Millard is altogether too enthusiastic over birth-control as we know it at present. Perhaps its methods are improving; but there seems more than a touch of irony in the statement that married people, if in doubt as to the best methods of birth-control to be adopted, "will naturally look to the medical profession for advice." How abundant and helpful that expert advice has been during the last quarter of a century!

The author has a fine passage on the joy and discipline of parenthood, and we agree with him that the availability of trustworthy counsel will encourage early marriages, which are on the victory side, we hope, in the campaign against "immorality" and venereal diseases. In any case, there is much to be said for Dr. Millard's summing-up, that "properly used, and not abused, birth-control is a valuable eugenic instrument, capable, by restricting the multiplication of the least fit, of greatly raising the quality of the race."

SIR ALEXANDER PEDLER, F.R.S.

THE announcement of the sudden death of Sir Alexander Pedler, while attending a Committee meeting at the Ministry of Munitions on Monday, May 13, came as a shock and great surprise to his many friends. There had been, among the majority of them, no suspicion of weakness, and to all appearance he was a man who might confidently look forward to many more years of useful work.

Pedler received his early education at the City of London School. The present writer made his acquaintance in October, 1866, when, at the age of seventeen, he won a Bell scholarship and began work as a student in the laboratory of the Pharmaceutical Society. Here he went through the usual course of analytical work, and at the end of the session was awarded a certificate of honour in practical chemistry. Before leaving, he began a piece of research suggested to him by the writer, who was then demonstrator in the school. It was with great regret that he parted with the promising young student, who had, by this time, decided to leave the comparatively narrow field of pharmacy and proceeded to place himself under Prof. (afterwards Sir Edward) Frankland at the Royal College of Chemistry, then in Oxford Street. There he soon entered on research and carried out the separation of the amylic alcohols by Pasteur's process. From the optically active and inactive alcohols thus obtained he prepared the corresponding valeric acids, and gave an account of the work to the Chemical Society in 1868 (J. Chem. Soc., N.S. 6, 74). Further work in this direction was interrupted by his taking part in the solar eclipse expedition of that year.

From 1871 Pedler served for two years as lecture demonstrator to Sir Edward Frankland in the Royal College of Chemistry in succession to Mr. Herbert McLeod, who had been appointed to the professorship of chemistry in the then newly instituted Royal Engineering College at Coopers

Hill. At that time he assisted in the research work on gaseous spectra in which Sir Edward Frankland and Sir Norman Lockyer were jointly occupied. This naturally turned Pedler's attention to the fascinating problems connected with the physical constitution of the sun and the stars. Consequently, on receiving, in 1873, the appointment as professor of chemistry in the Presidency College, Calcutta, it is not surprising to find that it was some years before he again gave special attention to ordinary terrestrial chemistry. The experience already gained qualified him for observation of meteorological phenomena, and soon after his arrival in India he was charged with special duty in connection with the eclipse expedition in 1875.

At this time, having been born in 1849, Pedler was still a very young man, and before quitting this portion of his career those who knew him in those early days will gladly recall the charming features of his character which made him not only popular in youth, but, remaining unchanged to his latest years, contributed so materially to his success in official life. Chemists who attend the long-established Chemical Dining Club are probably not all aware that it was started by Pedler in or about 1872, and that he acted as secretary so long as he remained in England.

In India, Pedler retained the professorship in Calcutta together with the office of Meteorological Reporter to the Government of Bengal for twenty-two years. He then became principal of the college and vice-chancellor of the Calcutta University. In 1899, he was appointed Minister of Public Instruction in Bengal and additional member of the Legislative Council. These successive steps in official life serve as sufficient explanation of the fact that Pedler's original contributions to scientific chemical literature were limited to the one paper on valeric acids, already mentioned, and several which naturally arose out of the conditions of his occupation in India. Soon after his arrival in that country he examined the coal-gas and the water supplies of Calcutta. In 1878 he sent home a paper on the cobra poison, which was printed in the Proceedings of the Royal Society (vol. xxvii., p. 17); while, in 1890, he contributed to the Journal of the Chemical Society three papers the titles of which show that he was utilising opportunities, previously neglected by chemists, of studying the action of tropical sunlight on chemical change.

On his retirement, Pedler received the honour of knighthood, and on his return to England, in 1906, he speedily found occupation in public work. He became honorary secretary to the British Science Guild, which owes much to his devoted service; and on the outbreak of war he took up active duties connected with the research department of the Ministry of Munitions.

Pedler was twice married, but left no children. His widow was the youngest daughter of the late Mr. Warburton, R.N., of Dedham.

W. A. T.

NOTES.

THE *Financier and Bullionist* of May 14 contains an important article by Sir William Tilden under the title "The Present Position of the Dye Question." The article is addressed mainly to business men, and is, therefore, pretty free from chemical technicalities. It sets forth clearly the causes—partly commercial, partly educational—which led to the decline of the British manufacture and the ascendancy and ultimate practical monopoly of the industry by Germany. The most serious weapon in the hand of the enemy, it is pointed out, is the position of respect which in Germany is accorded to science. The close relation of the universities to the industries of the country, and the fact that the German dye-makers have at their disposal a large body of trained experts, many of them distinguished chemists, who are not only employed in the works, but are also on the directorate, are the chief conditions of the success Germany has achieved in this direction. Sir Albert Stanley, President of the Board of Trade, announced in the House of Commons on May 15 the course which the Board, on behalf of the Government, proposes to take, among other things, in respect to the dye industry. The proposals include further financial aid to manufacturers of special colours and protection for a period of ten years after the war by controlling the importation of foreign dyestuffs by a system of licences. He also stated that negotiations were in progress for the amalgamation of British Dyes, Ltd., and Messrs. Levinstein, Ltd., who were the most important of the dye manufacturers in this country. The arrangements proposed provided for the new company being permanently under British control, for Government representation on the board of directors, and for securing reasonable prices and equitable distribution of the products to the dye-users, so as to avoid anything in the nature of a monopoly. This is all good so far as it goes, but the Government, any more than the man in the street, has not yet grasped the idea that this is a chemical business in the first place, and that to leave the direction chiefly in the hands of Government officials while the chemist is relegated to a subordinate position is to neglect the conditions which have been proved by long experience in Germany to be the only assurance of permanent security and success.

ATTENTION is directed in the *Times Engineering Supplement* for May to the part which technical production is taking in Germany in advancing the fertiliser problem, especially with regard to fertilisers capable of production from synthetic ammonia. For the manufacture of cheap hydrogen, a most essential factor in successful commercial ammonia synthesis, the Badische Anilin- & Soda-Fabrik has developed a catalytic hydrogen process in which large quantities of carbon dioxide are simultaneously obtained. The titles of a series of patents applied for by this company reveal the ideas whereby this by-product is to be utilised. A patent dated August 7, 1914, is concerned with "fertiliser." Three patents in December of the same year cover the manufacture of urea and of products and compounds for use in such manufacture. In June, 1915, a patent application for the manufacture of carbonic acid compounds of ammonia was filed; whilst in March, 1916, a further patent of the same company for fertiliser and method of fertilising was indicated. Obviously the object aimed at is the utilisation of the available carbonic acid from the hydrogen process in preference to the more expensive sulphuric acid necessary for the production of ammonium sulphate. The manufacture of urea would yield a fertiliser containing 43·7 per cent. of combined nitrogen as compared with 21·2 per cent. in sulphate of ammonia. This tendency in German fertiliser production merits especial consideration by those responsible for the erection of a Haber plant in this country, as indicated in the recent communication of Mr. Kellaway to the House of Commons, since, as a post-war proposition, such a plant would be employed for the manufacture of agricultural fertilisers. By close co-operation between those concerned in the production of hydrogen for synthetic ammonia and the experts in fertiliser values a decision should readily be reached as to the efficacy of carbonaceous ammonia compounds and derivatives, and consequently as to the best course of procedure in regard to hydrogen production.

In *La Nature* of May 4 Prof. L. de Launay publishes an authoritative article upon the economic importance of Alsace-Lorraine. As might be well supposed from its authorship, the article deals particularly with the mineral products, but refers also to the well-developed textile industries and the various forms of agricultural produce of this region. The author shows that in 1913 German Lorraine produced 21 million tons of iron ore out of a total production of 27·5 millions for Germany (including 6·5 million tons from Luxemburg), whilst French Lorraine produced 19·5 million tons out of a total of 21·7 millions from the whole of France, or a total of 47 million tons of iron ore produced by the whole Lorraine basin. He points out that the possession of this Lorraine iron-ore deposit was the basis not only of Germany's industrial strength, but also of her military power; it is only owing to the possession of this supply of iron ore that Germany has been able to continue the struggle for the last four years. Once, however, Lorraine becomes again a French possession, Germany will be unable to maintain in their present extension the works that produce her engines of destruction, and thus a result would be obtained which otherwise no league of nations, no international tribunal, no treaty capable of being torn up as occasion might require, could secure. Restitution of the Lorraine iron ore to its rightful French owners means, in fact, a guarantee of peace to the world. Of great importance, too, to France would be the Sarre coalfield, which belonged wholly to France up to 1815. When France re-enters into possession of this field, it will be able to supply a certain portion of her needs for coal, having an output of some 17 million tons of coal yearly. Another most valuable mineral product is to be found in the potash deposits of Mulhouse, discovered in 1904, but only slowly developed; the first pit was completed in 1911, in which year the output was 127,000 tons. It must be remembered, however, that Prussia, the owner of the Stassfurt potash deposits, was by no means anxious to see the Alsatian potash deposits developed in competition with the former, and that the Mulhouse deposits can produce very much more than they have done hitherto. Finally, there is a small oilfield just to the north-west of Strasburg, first discovered in 1880, and though far inferior in value to the iron, coal, and potash deposits, nevertheless, with its production of 50,000 tons of oil yearly, it is by no means devoid of importance for France.

The concluding Friday evening discourses at the Royal Institution are as follows:—On May 24, Lt.-Col. A. G. Hadcock on "Internal Ballistics"; on May 31, Mr. Laurence Binyon on "Poetry and Modern Life"; and on June 7, Sir Boverton Redwood on "The Romance of Petroleum."

The Duke of Northumberland, who died on May 14 at seventy-two years of age, was a familiar figure in the scientific world. He became a fellow of the Royal Society in 1900 under the rule which permits of the special election of Privy Councillors and men distinguished in the scientific or educational service of the State; and he had been for many years president of the Royal Institution. He was president of the Royal Archæological Institute from 1884 to 1892, and was elected a trustee of the British Museum in 1900.

Capt. Roald Amundsen's long-delayed North Polar Expedition is now announced to start from Norway next month. The *Maud*, the new vessel built for the expedition, is lying ready at Christiania. According to *La Géographie* (vol. xxxii., No. 1), the *Maud* is built on the lines of the *Fram*, and is a three-masted schooner furnished with a petrol motor and capable of a speed of nine knots. Her length is 120 ft., her beam measurement 40 ft., and her draught 12 ft. The screw can be raised to avoid ice-pressure. The petrol capacity of the vessel is 100 metric tons. The original plan of Capt. Amundsen was to enter the Arctic Ocean by Bering Strait. He now proposes to follow the route of the *Fram* through the Barents and Kara Seas along the coast of Asia, and to enter the polar pack about 250 miles east of the New Siberia Islands, allowing his vessel to be caught in the current which crosses the Arctic Ocean.

In *La Nature* for May 11 Lieut. Lefranc, of the French Air Service, gives very complete particulars of the armament and bomb-dropping arrangements of the modern types of German aeroplane. The armament comprises one or more machine-guns, generally mounted on turrets for securing motion in every direction, some firing through the propeller and synchronised by the aeroplane engine. Standard types of bombs are 22 lb., ½ cwt., 1 cwt., 2 cwt., and 6 cwt., charged with high explosive (T.N.T. and hexanitrodiphenylamine). The ratio of charge is very high. A special type of fuse is fitted in order to secure instantaneous or to delay action. Special frames (vertical or horizontal) are fitted for dropping the bombs, which are discharged in a direction tangential to their trajectory. An adapted Goerz sighting telescope in conjunction with a range-table and a direction or route corrector is employed for securing accuracy. Most bombs are fitted with stabilising vanes at their base in order to ensure the bombs falling nose-on, and to give them a certain amount of spin.

At the annual meeting of the Illuminating Engineering Society on May 14 the report of the council for the past session was presented. The society has been in communication with the authorities on various subjects, including economy in lighting with a view to fuel-saving, lighting arrangements for air-raid shelters, and the preparation of fuller statistics on the relation between illumination and street accidents. Two committees are carrying on researches for the authorities on parachute flares and luminous gun-sights. It is proposed to form a joint committee with the Ophthalmological Society, to which matters of mutual interest, comprising the effect of illumination on eyesight, can be referred. Following the conclusion of formal business, a discussion on the Lighting, Heating, and Power Order (1918) took place. Mr. L. Gaster, in opening the discussion, said that the society is anxious to assist the authorities to achieve the objects of the Order by preventing waste of light, but it is not desirable to diminish illumination to a value prejudicial to health or eyesight, liable to cause accidents, and interfering with efficiency of work. The maximum saving in fuel possible by the complete carrying out of the Order as regards lighting is small—probably within ½ per cent. of the normal total home coal consumption—but the psychological effect of extravagance in lighting must be considered. A series of recommendations on economy in lighting, prepared by the society with the concurrence of the Board of Trade, was presented. These explain the best methods of economising, importance being attached to avoidance of worn-out and inefficient lamps and burners and their use only when actually required, and to frequent cleansing of lamps and accessories liable to collect dust. In an appendix the essentials of good industrial lighting are stated, and some figures given for the illumination and consumption of gas or electricity considered desirable for various classes of work.

AN interesting address was delivered recently by Sir Robert Hadfield as president of the Society of British Gas Industries, ranging over a number of matters of current interest, such as the economy of fuel, particularly coal and coal-gas, the recent development of the metallurgical industry, scientific and technical education, trade and patent legislation. Sir Robert Hadfield lays much stress upon the very important present-day problem: how to bring about closer co-operation and greater working facilities amongst the numerous technical societies of the country. He points out that some even of our largest and most important societies have no homes of their own, but are, for the most part, housed in offices quite inadequate to the requirements of such important organisations. He quotes as an example the Iron and Steel Institute, representing an industry the annual value of the output of which is not less than two hundred millions sterling, which has offices in Victoria Street, Westminster, with its library placed in one or two small and inconvenient rooms, and contrasts this with the splendid library and spacious accommodation of the corresponding German institution. He urges wisely the need in this country for a central building in which all these technical societies would find a permanent home, with a common library, on similar lines to the Engineering Societies Building of New York, which he characterises as "the chief centre of the great and small technical societies of the great Republic." In addition to containing a fine technical library of more than 150,000 books, as well as the various offices and committee-rooms for twenty-four different societies, this building is closely connected with that of the Engineers' Club, where representatives of all branches of industry are able to meet each other; and Sir Robert Hadfield points out the real value to the technical man of such a common meeting ground.

IN the May issue of *Man* Sir C. H. Read discusses an article by Mr. More Adey in the March issue of the *Burlington Magazine* on "The Registration of Works of Art in Occupied Countries." How the Germans have dealt with the art treasures of the areas occupied by them is well known. The suggestion is that officers and men in Palestine, Mesopotamia, and the less explored frontiers of Egypt should register and preserve objects of art. Sir C. H. Read remarks that a large proportion of both officers and men of our forces now in Africa would welcome so intelligent a diversion from the routine of field or camp life. "The only danger that I foresee is lest some disciplinarian in a high place should promptly condemn the scheme as non-military and a waste of time." He suggests, to avoid this, that an order should be obtained from the War Office commending it as a means of putting the leisure of our soldiers to an intelligent use.

DR. W. L. HILDBURGH describes some Japanese charms connected with earthquakes in the April issue of *Man*. When an earthquake occurs a person in danger should repeat, over and over again, as rapidly as possible, the word *Manzairaku*, signifying "Ten thousand years of happiness." The term is used between persons as a form of congratulation; either on account of its congratulatory significance, or by some play of words, its use during an earthquake is intelligible. The Japanese, for some obscure reason, believe that a privy is the safest place of refuge during an earthquake. This may be due to the fact that the place is a haunt of spirits, and on leaving, one should throw there a piece of iron, like a nail, as a protection. On the whole, Dr. Hildburgh is disposed to connect the belief regarding the privy as analogous to the well-known principle of dressing children in dirty clothes as a charm against the Evil Eye or similar dangers.

BULLETIN No. 172 of the Agricultural Experiment Station of the Rhode Island State College contains the results of a study of infections of fowls by Messrs. P. Hadley and D. J. Lambert and Misses Dorothy Caldwell and Marguerite Elkins. It is established that *Bacterium pullorum* is the causative agent in an epidemic in adult fowls indistinguishable in its manifestations from fowl typhoid, which is caused by *B. gallinarum*. The two organisms may be distinguished by their fermentation reactions. The *B. pullorum* is present in 32 per cent. of the eggs of affected birds.

THE contention that isolation plays an important part in the evolution of species has long been accepted as a trustworthy working hypothesis, and during recent years an impressive array of evidence has been accumulated to justify this interpretation. The latest contribution to this subject has been made by Dr. Hart Merriam in a review of the grizzly and big brown bears of North America (Bureau of Biological Survey, Washington, North American Fauna, No. 41). In a review of this group twelve years ago the author recognised eight species of grizzly and brown bears. He has now increased this to eighty-six. This number, he remarks, "will appear to many preposterous"—unless they have the material before them which he has amassed. From the fine collection of skins and skulls which Dr. Merriam has brought together he has been enabled to show that no sharp dividing line can now be drawn between the grizzly and brown bears. Another surprising result is the discovery that Admiralty Island, off South-east Alaska, appears to be inhabited by no fewer than five distinct species of big bears, each of which is, apparently, related to, and representative of, an adjacent mainland species. In the matter of sexual differences Dr. Merriam is able to show that while the males commonly much exceed the females in the matter of size, in some species there is but little difference. A number of excellent photographs of skulls in profile accompany this paper, but, as the author remarks, they need to be supplemented by views showing the *Norma verticalis*, which furnishes some of the most important characters. Dr. Merriam's work will be read with the deepest interest not only by systematists, but also by those who are interested in the wider problems concerning the evolution of species.

BULLETIN No. 70 of the Agricultural Research Institute, Pusa, is an extremely useful summary by Mr. J. N. Sen, officiating Imperial agricultural chemist, of the composition of a great variety of feeding stuffs available in India, of which samples have been analysed in the laboratory of the Imperial agricultural chemist. The composition of each sample is set out in detail, so that the range of variation can be readily deduced. In addition to the ordinary analytical data, the albuminoid ratio and food units for each sample are given. The tables are prefaced by a brief introduction dealing with the general characteristics of food ingredients, digestibility, albuminoid ratios, food units, feeding standards, and the computing of rations. The bulletin gives the most comprehensive series of data available, and as such must be regarded as a valuable contribution to Indian agricultural reference literature.

THE Advisory Council of Science and Industry of the Commonwealth of Australia has issued a pamphlet (Bulletin No. 5) dealing with some problems of wheat storage. The bulletin is divided into two parts dealing respectively with damaged grain and insect pests. The former consists of the report of a committee appointed to investigate the utility of quicklime for the preservation of wheat, in accordance with a scheme outlined by Mr. A. O. Barrett. After careful investigation the committee recommends that the process shall be given a trial. Its experiments and observations indicate that ordinary wheat is improved by the treatment, the deterioration of damaged wheat is checked, and any mousy taint is removed. The growth of weevils was not inhibited, nor were their eggs and the young pupæ prevented from developing. The latter problem is dealt with more fully in the second part of the bulletin, which includes a summary of reports received from the Government entomologists of the various States as to insects damaging grain, and a progress report of the special committee on the damage to stored grain by insects. The committee recommends the appointment of a qualified investigator for systematic research on the life-history of the weevils in Australia and the best means of dealing with them, and this proposal is at present under consideration by the Wheat Board.

THE Weather Bureau of the United States Department of Agriculture has in active preparation an "Atlas of American Agriculture," for which the maps dealing with rainfall are practically finished. A copy of the map showing the mean annual rainfall of the United States was issued with the *Monthly Weather Review*, July, 1917, and has since been issued in a separate pamphlet. The map indicates in a marked degree the effect of the western mountains upon the distribution of the precipitation, and, in a less clear fashion, the similar effect of the eastern highlands, while it emphasises the run of the isohyets almost due north from the shores of the Gulf of Mexico between Galveston and the Rio Grande. In the accompanying text Prof. R. DeC. Ward discusses, among other topics, the climatic provinces of the United States. He divides the eastern half of the country into two provinces, Eastern and Gulf, and draws the boundary between them for the western third of its course at right angles to the north and south trend of the isohyets, so that the western third of the Gulf Province has an annual precipitation varying from 20 to 50 in. The Eastern Province contains examples of at least three types of rainfall: the summer rains of the north-west of the province, the coastal rains of the Atlantic lowlands, and an area of continuous rainfall at all seasons near the southern end of the eastern highlands; these subdivisions are ignored.

PROF. S. W. WILLISTON and his pupils continue to make important additions to our knowledge of American Permian Reptilia and Amphibia in the Contributions from Walker Museum (vol. ii., Nos. 1–3), published by the University of Chicago. Many of the fossils are, unfortunately, so badly preserved that there is scope for much difference of opinion as to their interpretation, but the skeleton in several genera is now becoming fairly well known. Some unusually good specimens of the strange Stegocephalian Diplocaulus have just been studied by Mr. Herman Douthitt, who shows that this animal must have been shaped and lived like a skate. Since Cope originally described its very short and broad triangular skull, there has been much speculation as to its nature, and Mr. Douthitt seems to have solved the problem. Some nearly complete skeletons of the primitive reptile Labidosaurus are discussed by Prof. Williston himself, who notes the absence of a neck and the unusual strength of the feet. There are large hook-like incisor teeth in front of the upper jaw, which might assist the feet in grubbing up worms and larvæ. Prof. Williston's studies have led him to make another effort to attain a natural classification of the reptiles. He recognises four main divisions or subclasses, all beginning in Palæozoic times, and all represented by their direct descendants to-day. The Diapsida end in the tuatera, crocodiles, and birds, the Synapsida in mammals, the Parapsida in lizards and snakes, and the Anapsida in tortoises and turtles.

UNDER the title "Physics of the Air," Prof. W. J. Humphries, of the United States Weather Bureau, has been contributing to the Journal of the Franklin Institute since August last a series of articles on the physics of meteorological phenomena. The March issue of the Journal, *e.g.*, contains a description of the seasonal and daily changes of barometric pressure and a discussion of their causes, and the thirteen pages form chap. xi. of the series. Together they constitute a notable addition to the literature of meteorology, and it is to be hoped that the articles will be reissued in book form, so as to be accessible to the large number of readers interested in the fundamental facts of meteorology. For such readers there has, up to the present, been no trustworthy English text-book which discussed the subject from so scientific a viewpoint or dealt with its modern developments so completely.

THE *Photographic Journal* for April contains a description of the photometer for measuring the densities of photographic negatives shown at the March meeting of the Royal Photographic Society by its inventors, Messrs. Benson, Ferguson, and Renwick. The negative is placed on an opal half an inch in diameter, the top surface of which is level with that of a small table in which the opal is inserted. Light from a 15-candle-power headlight lamp placed under the table passes through the opal and negative. Light from the same lamp falls on movable mirrors, by means of which it is thrown on to the under-surface of a second opal near the first, and the distance of the mirrors from the lamp is adjusted until the two opals have the same intensity as determined by a Lummer-Brodhun cube above the table. In describing the instrument at the meeting, Mr. Renwick pointed out that the time had arrived when eye-estimates of densities were no longer sufficiently accurate to enable progress to be made in ascertaining the conditions which determine the density of a negative. In a paper which precedes the description of the photometer in the *Journal*, he shows that the optical properties of the silver grains must be taken into account before photographic densities can be explained satisfactorily.

THE "natural" or spontaneous coagulation of the latex in the production of rubber has been attributed, on one hand to enzyme action, and on the other to the agency of bacteria. Mr. M. Barrowcliff, in the Journal of the Society of Chemical Industry for February 15, adduces good evidence in support of the former theory. Coagulation of latex was found to take place in normal time after addition of toluol, which acts as a bactericide, but is non-toxic to enzymes. Similarly, the addition of thymol did not inhibit or retard coagulation. Small quantities of soluble calcium salts greatly accelerated the action, as is usual with enzymes; but hydrocyanic acid, which is fatal to nearly all enzymes, completely prevented coagulation. Even the "acid" process of coagulation is considered to be enzymic, the added acid functioning as an enzyme activator.

At the present time there is only one calcium carbide factory in Great Britain; it is situated in Manchester, and is just now being enlarged to meet war requirements. There are also two small factories in Ireland, the electric current for which is supplied by water-power; but the supply of water is small and erratic, and the output of calcium carbide is only about 1 per cent. of our normal consumption. Mr. C. Bingham (Journal of the Society of Chemical Industry, March 15) gives reasons for the conclusion that in peace times we shall be quite unable to compete with water-power countries like Norway in the production of calcium carbide, unless very much more economical methods than the present ones can be found for producing electricity. From an experimental study of the question he believes this can be done by utilising waste gases from blast-furnaces and coke-ovens as the source of power for generating the current required.

In the Journal of the Society of Chemical Industry for January 31 Dr. T. Rettie gives an account of work done on antiseptics for the Medical Research Committee at the Pathological Department, Edinburgh University. An urgent requirement of the medical service at the war front was a trustworthy antiseptic for the treatment of heavily infected wounds, with special reference to spore-bearing organisms. The object, therefore, was to find an antiseptic agent thoroughly efficient as a killer of bacteria and spores, and at the same time harmless in its effect on the wound-tissues. Of the various substances tested the hypochlorites were found to be the most efficient germicides. Pure solution of bleaching powder, however, and also sodium hypochlorite solution, are drastic remedies, and on account of their strong alkalinity and high chlorine content they are unsuitable for continued application to wounds. On the other hand, aqueous solutions of hypochlorous acid itself are also unsuited for wound treatment, by reason of the fact that free chloric and hydrochloric acids develop in them through spontaneous reaction. These defects were largely overcome by using a mixture of equal weights of boric acid and bleaching powder ("Eupad"—a name derived from the initial letters of Edinburgh University Pathological Department). An aqueous solution of this ("Eusol") is prepared, of strength 25 grm. per litre; it contains about 0·26 per cent. of hypochlorous acid, together with calcium biborate. In this way the alkalinity of the bleaching powder is reduced, the full effect of the hypochlorous acid secured, and the solution cannot become unduly acid, as the dissociation constant for boric acid has a very low value. Hence the solution can be applied freely to the body tissues, and a large quantity can even be injected into the circulatory system without harmful effect. This solution has been used successfully both for the treatment of wounds and, by intravenous injection, in certain types of gas-gangrene toxæmia.

The announcements of Messrs. *Longmans and Co.* include "Elements of the Electromagnetic Theory of Light," by Dr. L. Silberstein, and (in the series of Text-books of Physical Chemistry) a new edition of Prof. S. Young's "Stoichiometry," containing re-written chapters dealing with the more recent determinations of the atomic weights of silver, nitrogen, chlorine, and lead. Messrs. *G. Routledge and Sons, Ltd.*, are to publish "Wealth from Waste: Elimination of Waste a World Problem," by Prof. H. J. Spooner, with a foreword by Lord Leverhulme. Messrs. Routledge also announce "Incidents in the Life of a Mining Engineer," by E. T. McCarthy. Messrs. *Constable and Co., Ltd.*, will shortly publish "The Future Citizen and his Mother," by Dr. C. Porter, with a foreword by Sir J. Crichton Browne. Messrs. *Henry Frowde and Hodder and Stoughton* have in the press "Vaccines and Sera," by Capt. A. G. Shera, and "The Hearts of Man," by R. McNair Wilson.

OUR ASTRONOMICAL COLUMN.

Minor Planets.—The following ephemerides of Pallas and Ceres are from the Rechen-Institut's List:—

Pallas: Magnitude 8·8.

Date	R.A. h. m.	N. Decl. ° ′	Log *r*	Log Δ
May 26	17 9·4	25 19	0·489	
June 3	17 2·6	25 46		0·368
11	16 55·7	25 53		0·372
19	16 49·2	25 39		0·379
27	16 43·4	25 6		0·388
July 5	16 38·6	24 17	0·500	

Ceres: Magnitude 7·6.

Date	R.A. h. m.	S. Decl. ° ′	Log *r*	Log Δ
June 11	18 23·9	25 57	0·457	
19	18 16·4	26 29		0·269
27	18 8·6	26 58		0·270
July 5	18 0·9	27 23		0·274
13	17 54·0	27 44		0·283
21	17 48·2	28 1	0·461	

Planet 31 Euphrosyne was observed on April 13 and 14; the ephemeris needs the large corrections −12·4m. + 3° 12′. The interesting planet DB, discovered by Wolf on January 3, has been named Alinda.

Currents in the Upper Air.—The behaviour of the streaks or trains left by large meteors supplies abundant evidence as to the rapid motion of the atmosphere at its outer limits. The diversity of direction, as well as the rate of velocity, of these upper winds is remarkable; in fact, hurricane speed would appear to be quite a common feature amongst them. It is true that the data are not of sufficiently accurate character to allow very exact deductions to be drawn, but there is no doubt as to the general correctness of the results. In some instances the observations have been as complete as they have been precise, and these corroborate in a very satisfactory manner the average values obtained from more uncertain or incomplete records.

The long-enduring streaks of swift fireballs, like the Perseids and Leonids, are usually about fifty-five or sixty miles in height, but they may extend from heights of fifty to seventy miles. The mean velocity of their drift is 121 miles per hour, and the predominating direction to the eastward, but there is no quarter to which these lofty cosmic clouds may not be carried. Of seventy-eight enduring meteoric streaks motion was found to be directed to points at or between north-east and south-east in thirty-seven cases, while to the points north-west to south-west there were only twenty-four. The individual velocities varied from nil to 360 miles per second. In some cases a moderate speed of twenty-seven or thirty miles per hour was indicated. Certain streaks gave evidence of a series of differing currents underlying each other, the upper sections drifting in different directions to the lower.

DISTANCE OF THE ORION NEBULA.—An interesting estimate of the distance of the Orion nebula has been made by Prof. W. H. Pickering (Harvard Circular No. 205). From a consideration of the brightnesses and distribution of the stars in the nebula and in the surrounding region, it is concluded that practically all the stars within the nebula are of type B, and that there are no stars in the nebula fainter than fifteenth magnitude. Since we are looking very nearly along the axis of the great spiral nebula which stretches over nearly the whole length of Orion, and is connected with the great nebula, all the stars associated with it must be at approximately the same distance from us. Russell has shown that only very massive stars can attain the colour of type B; and assuming 10·5 as the mean magnitude of the stars within the nebula, while the average absolute magnitude of such stars may be taken as −1·0, it follows that the distance of the nebula is 6520 light-years, or that the parallax is 0·0005″. Among the interesting results which follow, the mean diameter of the brilliant Huygenian region is found to be 6·3 light-years, and the distance between the extreme stars of the trapezium 0·68 light-year. It is also calculated that Rigel is 2,100,000 times as bright as the sun, thus far exceeding Canopus, for which Walkey estimated a brightness of 50,000 times that of the sun.

TERRESTRIAL MAGNETIC OSCILLATIONS.

THE paper referred to below [1] is an important contribution to our knowledge of oscillations in the magnetic elements, especially those of shorter period termed "pulsations" by van Bemmelen. The records were obtained in an underground chamber near the Marine Biological Laboratory at Misaki, between 1910 and April, 1914, with a special set of very sensitive magnetographs, designed by Prof. Tanakadate. The magnetographs, which recorded the north (N), west (W), and vertical (V) components, show several original features. The V instrument, which worked very satisfactorily, had the magnet carried by horizontal quartz fibres. The sensitiveness of the instruments was about 0·15 γ per 1 mm., and the time-scale about 3½ mm. to the minute.

The original object was to ascertain whether seismic movements were accompanied by magnetic waves. No certain connection was established, but many interesting records of pulsations were obtained. The distribution of pulsations throughout the twenty-four hours varied markedly with the period, waves with periods less than seventy seconds having their maximum frequency during the day, and those with periods longer than ninety seconds having their maximum during the night. Periods shorter than thirty seconds were rare. Pulsations in V were almost facsimiles of those in N, except that they were of smaller amplitude and had a retardation of phase. As the period became longer, the ratio borne by the amplitude of the V to that of the N pulsation increased, while the difference in phase diminished. The hour of the day seemed without direct influence on the value of the ratio. The relation between the pulsations in N and W, on the other hand, depended largely on the hour of the day. Regarding north and west as the positive directions in the two cases, it was found that agreement in phase between N and W pulsations was most frequent in the early morning, whilst direct opposition in phase was most frequent in the evening. Cases in which the N pulsation was largely dominant were most frequent near noon and near midnight.

Generally there was a marked tendency in the vector in the horizontal plane to rotate, after the fashion first described by R. B. Sangster for longer-period movements. According to the author, in pulsations at Misaki, clock-wise rotation is most frequent between sunrise and noon, and again between sunset and midnight, anti-clock-wise rotation predominating in the intermediate hours. One interesting feature, which the author thinks may possess considerable significance, is a tendency when pulsations start abruptly for N to show a rapid rise. He is disposed to attribute pulsations to fluctuations in the electrical currents in the upper atmosphere, to which the regular diurnal magnetic variation is now generally ascribed. If, as he thinks most likely, pulsations arise simultaneously and not successively at different stations, the currents in the upper atmosphere probably fluctuate in intensity as well as in position. This might, he thinks, arise from vertical oscillations in limited portions of the upper atmosphere. A variety of mathematical problems relating to oscillating linear electric currents are worked out. The plates at the end contain numerous interesting examples of pulsations.

C. CHREE.

[1] "On Rapid Periodic Variations of Terrestrial Magnetism." By Torahiko Terada. Journal of the College of Science, Imperial University of Tokyo, vol. xxxvii., 1917, Art. 9. Pp. 85+5 plates.

GLOBULAR STAR CLUSTERS.

MR. HARLOW SHAPLEY'S preliminary work on the distances of the globular clusters attracted much attention two years ago. He has since then diligently pursued the subject, and gives an interesting summary of the progress of his researches in Pubns. Astr. Soc. Pac., February, 1918.

His methods are:—(1) To determine the photographic and photo-visual magnitudes of the cluster stars by photographs on ordinary and panchromatic plates. The colour-indices of the stars are thus determined and their spectral types inferred. The fact that stars are found in the clusters quite as blue as the B stars in our neighbourhood leads to the assumption that light absorption is negligible. The distances can then be inferred, making assumptions on the absolute magnitudes of stars of different spectral types.

(2) The work of Miss Leavitt, Hertzsprung, and Shapley shows that the absolute magnitude of Cepheid variables is a function of the period of light variation. A curve is given in the article, from which the following values have been measured:—

Period (days)	Abs. mag.	Period (days)	Abs. mag.
63	−6	4·9	−2
33	−5	1·7	−1
17	−4	0·85	−0·5
9·2	−3	0·7 (and under)	−0·3

Since the cluster variables conform mainly to the Cepheid type, this affords a very accurate means of obtaining the distances of clusters. Mr. Shapley notes that the long-period Cepheids are the most luminous of all stars. The longest observed period is about 130 days, absolute magnitude −6·8 (indicating about 50,000 times the luminosity of the sun). Cepheid variables are also notable for their rapid motion, which appears to average more than 100 km./sec.

(3) By the above methods the average absolute magnitude (photographic) of the brighter stars of the different clusters (twenty-five stars selected from each cluster, rejecting the five brightest) is found to be −1·5. Making this assumption for other clusters, we can estimate their distance without waiting for more detailed researches.

(4) There is found to be a fairly close correlation between distance and apparent diameter, indicating that the linear diameter of a cluster is a function of its distance. With diameter 1·4′ corresponds distance

130,000 light-years; 3·9′, 65,000 L.Y.; 7·7′, 43,000 L.Y.; 12·4′, 33,000 L.Y.; 20′, 26,000 L.Y.

These methods have been applied to finding the distances of sixty-nine globular clusters. The nearest are ω Centauri and 47 Tucanæ, 23,000 L.Y.; the average distance is 75,000 L.Y.; seventeen clusters are more distant than 100,000 L.Y.; the most distant is N.G.C. 7006, some 200,000 L.Y. (more than a trillion miles, using the British system of numeration).

The distribution in galactic longitude is curious. There are none between 45° and 190°, while more than half are between 300° and 350°. In latitude there are maxima on each side of the galaxy, with a gap in the galactic plane itself. The system forms a split ellipsoid with longest diameter some 300,000 L.Y., and distance of centre 65,000 L.Y. The co-ordinates of the centre are R.A. 17h. 30m., S. decl. 30°. While lying outside the galactic limits, the distribution of the clusters indicates that they form part of the same cosmic unit as the galaxy. Some preliminary investigations of their radial velocities by Prof. Slipher indicate that these are high, but smaller than those of the spiral nebulæ. A. C. D. CROMMELIN.

FROST IN THE UNITED STATES.

IN a paper with the above title presented before the second Pan-American Scientific Congress at Washington (Washington: Government Printing Office, 1917) Mr. William Gardner Reed discusses the damage by frost in the United States. Following the rule of the Weather Bureau, he classifies frosts as "light," "heavy," and "killing," but he determines the dates of the last killing frost in spring and the earliest in autumn from the records of temperature, and not from the reports of damage. This is fully justified by the fact that the observations of temperature are continuous and exact, whereas the damage depends on many conditions.

The number of observations at any one individual station is seldom sufficient to show the precise chance of frost after a given date at that particular station, but if the observations at neighbouring stations are utilised, a sort of general mean date for the last frost in a district can be obtained. Working on these lines, Mr. Reed gives maps of the United States with lines showing the limits for killing frosts at various dates, the consecutive lines showing differences of ten days in the date. Thus the date for a line running close to the Gulf of Mexico is March 1, but for a line near the Canadian boundary it is as late as May 21.

The mean date of the last or earliest frost is not of much importance to the cultivator; he wants to know the date beyond which he will be reasonably safe from damage. For this purpose Mr. Reed calculates the standard deviation of the date, and since he finds that the distribution follows the normal curve, he is thus able to give the date beyond which a killing frost is not likely to occur more than once in ten years. This is, no doubt, a much more trustworthy method than using the extreme dates at each separate station. Charts are prepared in a similar way for the first killing frost in autumn; near the Canadian boundary the date is as early as September 1, but delayed until November 1 near the Gulf Coast.

The meteorological conditions that favour frost are not quite the same over the different States, though they are, in general, the clear skies of an anticyclone with their local nocturnal cooling. As a rule, east of the Rocky Mountains the frost area is south-east, and somewhat in advance of the anticyclone. In California north-easterly and easterly winds prevail for twenty-four or thirty-six hours beforehand, and a frost occurs if a clear sky accompanies the dropping of the wind.

Mr. Reed also discusses the cause why plants are damaged by frost, and arrives at the conclusion that the matter is far from being well understood. It is a very common belief that the damage is not so serious if the rise of temperature is slow, but Mr. Reed says that recently accumulated evidence throws some doubt upon this. He appears to hold that the length of time during which the trees are exposed to the cold is of importance, and that even if the heating of an orchard has been delayed until after the critical temperature is reached, there may still be time to save the fruit; and he concludes this part of his subject by saying that "evidently much more investigation is needed concerning the nature of frost effects within the plant."

CONSTRUCTION FOR AN APPROXIMATE QUADRATURE OF THE CIRCLE.

THE issue of the *Comptes rendus* of the Paris Academy of Sciences for March 25 last contains a paper by M. de Pulligny on a simple geometrical representation of the approximations to the numerical value of π given by Archimedes and Metius. Other approximations can be represented in the same way.

The construction is as follows:—Let OA and OB be two radii of a circle at right angles to one another. Let S be the mid-point of OA. Draw through S a line cutting the circle in P and Q, and OB (produced if necessary) in R. Let $OA=a$, $OR=ya$, $PQ=u$. Then we have $u^2=\{4-4y^2/(1+4y^2)\}a^2=$(say) ma^2. As PQ rotates round S, y varies continuously from 0 to ∞, and m from 4 to 3. When $y=0$, the square on PQ is greater than the area of the circle; when $y=\infty$, it is less: thus, in intermediate positions of the chord, the square on PQ gives an approximate quadrature of the circle, and m gives an approximate value of π.

The point R determines the chord PQ. If on AO produced we take a point I so that $4.AI=5a$, and if with I as centre and IA as radius we draw a circle cutting OB produced in R, we have $y^2=3/2$, and $m=22/7$, the higher limit given by Archimedes.

If on AO produced we take a point J so that $8.OJ=a\sqrt{3}$ (a result for which a geometrical construction can be easily given), and if with J as centre and IA as radius we draw a circle cutting OB produced in R, we have $y^2=(6+1/16)/4$, and $m=355/113$, the approximation given by Metius.

It will be noticed that there is nothing in this construction to enable us to fix the limits within which we must choose R to get a close approximation; but corresponding with any assigned value of m, and therefore of y, it gives a geometrical construction for the side of the square thus determined.

W. W. ROUSE BALL.

RADIATION AND THE ELECTRON.[1]

RECENT developments in the domain of radiation are of extraordinary interest and suggestiveness, but they lead into regions in which the physicist sees as yet but dimly—indeed, even more dimly than he thought he saw twenty years ago.

But while the beauty of a problem solved excites the admiration and yields a certain sort of satisfaction, it is, after all, the unsolved problem, the quest of the unknown, the struggle for the unattained, which is of universal and most thrilling interest. I make no

[1] Address to the Section of Physics and Chemistry of the Franklin Institute, Philadelphia, on January 4, 1917, by Prof. R. A. Millikan, professor of physics in the University of Chicago. The substance of this lecture has since been incorporated into a book recently issued by the University of Chicago Press, entitled "The Electron."

apologies, therefore, for presenting to-night one of the great unsolved problems of modern physics, nor for leaving it with but the vaguest of suggestions towards a solution.

The newest of the problems of physics is at the same time the oldest. For nothing is earlier in the experiences either of the child or of the race than the sensation of receiving light and heat from the sun. But how does light get to us from the sun and the stars through the empty interstellar spaces? The Greeks answered this query very simply and very satisfactorily from the point of view of people who were content with plausible explanations, but had not yet learned perpetually to question Nature experimentally as to the validity or invalidity of a conclusion. They said that the sun and all radiators of light and heat must shoot off minute corpuscles the impact of which upon the eye or skin produces the sensations of light and warmth.

This corpuscular theory was the generally accepted one up to A.D. 1800. It was challenged, it is true, about 1680 by the Dutch physicist Huygens, who, starting with the observed phenomena of the transmission of water waves over the surface of a pond or of sound waves through the air, argued that light might be some vibratory disturbance transmitted by some medium which fills all interstellar space. He postulated the existence of such a medium, which was called the luminiferous or light-bearing æther.

Partly no doubt because of Newton's espousal of the corpuscular theory, the æther or wave theory gained few adherents until some facts of interference began to appear about 1800, which baffled explanation from the point of view of the corpuscular theory, but were easily handled by its rival. During the nineteenth century the evidence became stronger and stronger, until by its close the corpuscular theory had been permanently eliminated for four different reasons: (1) The facts of interference were not only found inexplicable in terms of it, but also completely predicted by the wave theory. (2) The fact that the speed of propagation of light was experimentally found to be greater in air than in water was in accord with the demands of the æther theory, but directly contrary to the demands of the corpuscular theory. (3) Wireless waves had appeared and been shown to be just like light waves save for wave-length, and they had been found to pass over continuously, with increasing wave-length, into static electrical fields such as could not possibly be explained from a corpuscular point of view. (4) The speed of light had been shown to be independent of the speed of the source as demanded by the æther theory and denied by the corpuscular theory.

By 1900, then, the æther theory had become apparently impregnably entrenched. A couple of years later it met with some opposition of a rather ill-considered sort, as it seems to me, from a group of extreme advocates of the relativity theory, but this theory is now commonly regarded, I think, as having no bearing whatever upon the question of the existence or non-existence of a luminiferous æther. For such an æther was called into being solely for the sake of furnishing a carrier for electromagnetic waves, and it obviously stands or falls with the existence of such waves *in vacuo*, and this has never been questioned by anyone so far as I am aware.

Up to 1903, then, the theory which looked upon an electromagnetic wave as a disturbance which originated at some point in the æther at which an electric charge was undergoing a change in speed, and was propagated from that point outward as a spherical wave or pulse, the total energy of the disturbance being always spread uniformly over the wave front, had met with no serious question from any source. Indeed, it had been extraordinarily successful, not only in accounting for all the known facts, but also in more than one instance in predicting new ones. The first difficulty appeared after the discovery of the electron and in connection with the relations of the electron to the absorption or emission of such electromagnetic waves. It was first pointed out in 1903 by Sir J. J. Thomson in his Silliman lectures at Yale. It may be stated thus:

X-rays unquestionably pass over, or by, all but an exceedingly minute fraction, say one in a thousand billion, of the atoms contained in the space traversed without spending any energy upon them or influencing them in any observable way. But here and there they find an atom from which, as is shown directly in C. T. R. Wilson's photographs (Figs. 1 and 2), they hurl a negative electron with enormous speed. This is the most interesting and most significant characteristic of X-rays, and one which distinguishes them from the α and β rays just as sharply as does the property of non-deviability in a magnetic field; for

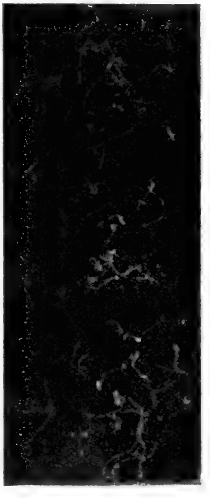


FIG. 1.—Tracks of β particles ejected by X-rays from molecules of air.

FIG. 2.—Tracks of α rays in air.

neither α nor β rays ever eject electrons from the atoms through which they pass with speeds comparable with those produced by X-rays, else there would be new zigzag lines branching out from points all along the paths of the α and β particles shown in the Wilson photographs.

But this property of X-rays introduces a serious difficulty into the æther theory. For if the electric intensity in the wave front of the X-ray is sufficient thus to hurl a corpuscle with huge energy from one particular atom, why does it not at least detach corpuscles from all the atoms over which it passes?

Again, when ultra-violet light falls on a metal it, too, like X-rays, is found to eject negative electrons. This phenomenon of the emission of corpuscles under the influence of light is called the photo-electric effect. Lenard (*Ann. d. Phys.* [4], vol. viii. [1902], p. 149) first made the astonishing discovery that the energy of ejection of the corpuscle is altogether independent of the intensity of the light which causes the ejection, no matter whether this intensity is varied by varying the distance of the light or by introducing absorbing screens. I have myself (*Phys. Rev.*, vol. ii. [1913], p. 173) subjected this relation to a very precise test and found it to hold accurately. Furthermore, this sort of independence has also been established for the negative electrons emitted by both X- and γ rays.

Facts of this sort are evidently difficult to account for on any sort of a spreading-wave theory. But it will be seen that they lend themselves to easy interpretation in terms of a corpuscular theory, for if the energy of an escaping electron comes from the absorption of a light-corpuscle, then the energy of emission of the ejected electron ought to be independent of the distance of the source, as it is found to be, and, furthermore, corpuscular rays would hit but a very minute fraction of the atoms contained in the space traversed by them. This would explain, then, both the independence of the energy of emission upon intensity and the smallness of the number of atoms ionised.

In view, however, of the four sets of facts mentioned above, Thomson found it altogether impossible to go back to the old and exploded form of corpuscular theory for an explanation of the new facts as to the emission of electrons under the influence of æther waves. He accordingly attempted to reconcile these troublesome new facts with the wave theory by assuming a fibrous structure in the æther and picturing all electromagnetic energy as travelling along Faraday lines of force conceived of as actual strings extending through all space. Although this concept, which we shall call the æther-string theory, is like the corpuscular theory in that the energy, after it leaves the emitting body, remains localised in space, and, when absorbed, is absorbed as a whole, yet it is after all essentially an æther theory. For in it the speed of propagation is determined by the properties of the medium and has nothing to do with the nature or condition of the source. Thus the last three of the fatal objections to a corpuscular theory are not here encountered. As to the first one, no one has yet shown that Thomson's suggestion is reconcilable with the facts of interference, though, so far as I know, neither has its irreconcilability been as yet absolutely demonstrated.

But interference aside, all is not simple and easy for Thomson's theory. For one encounters serious difficulties when he attempts to visualise the universe as an infinite cobweb the threads of which never become tangled or broken, however swiftly the electrical charges to which they are attached may be flying about.

Yet the boldness and the difficulties of Thomson's "æther-string" theory did not deter Einstein (*Ann. d. Phys.* [4], vol. xvii. [1905], p. 132; vol. xx. [1906], p. 199) in 1905 from making it even more radical. In order to connect up with some results to which Planck, of Berlin, had been led in studying the facts of black-body radiation, Einstein assumed not only that the energy emitted by any radiator kept together in bunches or quanta as it travelled through space, as Thomson had assumed it to do, but also that a given source could emit and absorb radiant energy only in units which are all exactly equal to $h\nu$, ν being the natural frequency of the emitter and h a constant which is the same for all emitters.

I shall not attempt to present the basis for such an assumption, for, as a matter of fact, it had almost none at the time. But whatever its basis, it enabled Einstein to predict at once that the energy of emission of corpuscles under the influence of light would be governed by the equation

$$\tfrac{1}{2}mv^2 = Ve = h\nu - p \quad\ldots\ldots\ldots\ldots(41)$$

in which $h\nu$ is the energy absorbed by the electron from the light wave or light quantum, for according to the assumption that it was the whole energy contained in that quantum, p is the work necessary to get the electron out of the metal, and $\frac{1}{2}mv^2$ is the energy with which it leaves the surface—an energy evidently measured by the product of its charge e by the potential difference V, against which it is just able to drive itself before being brought to rest.

At the time at which it was made this prediction was as bold as the hypothesis which suggested it, for at that time there were available no experiments whatever for determining anything about how the positive potential V necessary to apply to the illuminated electrode to stop the discharge of negative electrons from it under the influence of monochromatic light varied with the frequency ν of the light, or whether the quantity h to which Planck had already assigned a numerical value appeared at all in connection with photo-electric discharge. We are confronted, however, by the astonishing situation that after ten years of work at the Ryerson Laboratory and elsewhere in the discharge of electrons by light this equation of Einstein's seems to us to predict accurately all the facts which have been observed.

The method which has been adopted in the Ryerson Laboratory for testing the correctness of Einstein's

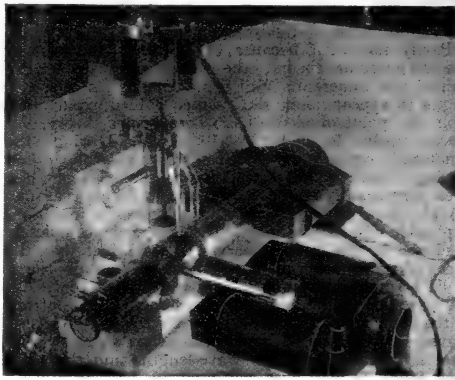


FIG. 3.—Photograph of apparatus used for the photo-electric determinatio of Planck's h.

equation has involved the performance of so many operations upon the highly inflammable alkali metals in a vessel which was freed from the presence of all gases that it is not inappropriate to describe the present experimental arrangement as a machine-shop *in vacuo*. Fig. 3 shows a photograph of the apparatus, and Fig. 4 is a drawing of a section which should make the necessary operations intelligible.

One of the most vital assertions made in Einstein's theory is that the kinetic energy with which monochromatic light ejects electrons from any metal is proportional to the frequency of the light, *i.e.* if violet light is of half the wave-length of red light, then the violet light should throw out the electron with twice the energy imparted to it by the red light. In order to test whether any such linear relation exists between the energy of the escaping electron and the light which throws it out it was necessary to use as wide a range of frequencies as possible. This made it necessary to use the alkali metals, sodium potassium, and lithium, for electrons are thrown from the ordinary metals only by ultra-violet light, while the alkali metals respond in this way to any waves shorter than those of the red—that is, they respond throughout practically the whole visible spectrum as well as the ultra-violet spectrum. Cast cylinders of these metals were therefore placed

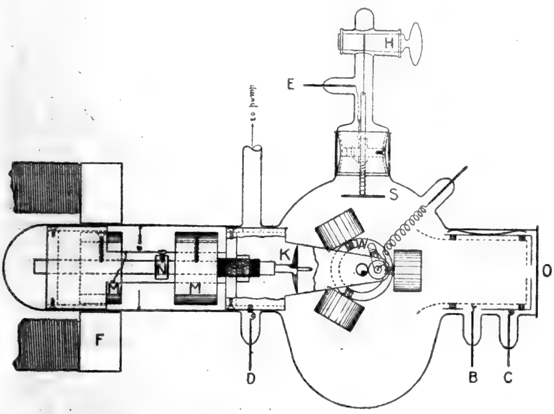


FIG. 4.—Cross-sectional drawing of apparatus of Fig. 3.

on the wheel W (Fig. 4), and fresh, clean surfaces were obtained by cutting shavings from each metal in an excellent vacuum with the aid of the knife K, which was operated by an electromagnet F outside the tube. After this the freshly cut surface was turned around by another electromagnet until it was opposite the point O of Fig. 4, and a beam of monochromatic light from a spectrometer was let in through O and allowed to fall on the new surface. The energy of the electrons ejected by it was measured by applying to the surface a positive potential just strong enough to prevent any of the discharged electrons from reaching the gauze cylinder opposite (shown in dotted lines) and thus communicating an observable negative charge to the quadrant electrometer which was attached to this gauze cylinder. For a complete test of the equation it was necessary also to measure the contact-electromotive force between the new surface and a test plate S. This was done by another electromagnetic device

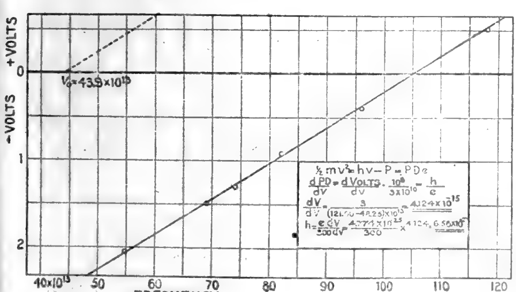


FIG. 5.—Graph showing relation between energy of electric emission and frequency of the light which stimulates the emission.

shown in Fig. 3, but for further details the original paper may be consulted (see *Phys. Rev.*, vol. vii. [1916], p. 362). Suffice it here to say that Einstein's equation demands a linear relation between the applied positive volts and the frequency of the light, and it also demands that the slope of this line should be exactly equal to h/e. Hence from this slope, since e is known, it should be possible to obtain h. How perfect a linear relation is found may be seen from Fig. 5, which also shows that from the slope of this line h is found to be $6{\cdot}56 \times 10^{-27}$, which is as close to the value obtained by Planck from the radiation laws as is to be expected from the accuracy with which the experiments in radiation can be made. The most trustworthy value of h obtained from a consideration of the whole of this work is $h = 6{\cdot}56 \times 10^{-27}$. In the original paper will be found other tests of the Einstein equation, but the net result of all this work is to confirm in a very complete way the equation which Einstein first set up on the basis of his semi-corpuscular theory of radiant energy. And if this equation is of general validity it must certainly be regarded as one of the most fundamental and far-reaching of the equations of physics, and one which is destined to play in the future a scarcely less important *rôle* than Maxwell's equations have played in the past, for it must govern the transformation of all short-wave-length electromagnetic energy into heat energy.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The thanks of the Senate have been accorded to the Worshipful Company of Drapers for the renewal, at the rate of 300*l.* a year for 1918 and 1919, of their grant in aid of the biometric laboratories of the department of applied statistics at University College; and to the Chadwick trustees for the renewal of their grant of 250*l.* in furtherance of the promotion of sanitary science by aiding the maintenance of the Chadwick professorship of hygiene and the teaching of municipal engineering at University College during the year 1918–19, and for their continued provision of the Chadwick gold medal.

The Senate has adopted a resolution expressing gratification that the London Hospital has decided to open its medical college to women students—"a step which is in entire conformity both with the wishes and the policy of the University."

The following doctorates have been conferred:—*D.Sc. in Statistics:* Mr. R. J. Ewart, an internal student, of the Lister Institute of Preventive Medicine, for a thesis entitled "The Influence of Age of Parent at Birth on Length of Life, Sex, Susceptibility to Zymotic Diseases, Stature, Intelligence, and Eye-colour." *D.Sc. in Botany:* Mr. Walter Watson, an external student, for a thesis entitled "The Bryophytes and Lichens of Various Ecological Groups of Vegetation," and other papers. *D.Sc. in Physics:* Mr. E. N. da Costa Andrade, an external student, for a thesis entitled "The Flow of Metals under Constant Stresses," and other papers.

THE remaining public lectures of the course on "Some Biological Problems of To-day" will be delivered at University College, London (Gower Street, W.C.1), on Mondays at 5 p.m., as follows:—May 27, "Substitution of Raw Materials," by Prof. F. W. Oliver; June 3, "The Anaerobic Treatment of Wounds," by Dr. R. C. McLean; and June 10, "Fresh Air and Efficiency," by Prof. H. R. Kenwood.

The Registrar of the Institute of Chemistry has been informed by the Board of Education that "instructions have been given by the National Service Department to defer, for the present, the calling up of any student of chemistry attending a teaching institution recognised by the Board of Education or the Scotch Education Department who has not been or is not placed in Grade I. and produces a certificate from the principal of the institution that he has passed his matriculation or corresponding examination, and is taking a full course of study in science, including chemistry. The Board further understands that calling-up notices (including any already issued) may, if necessary, be suspended for fourteen days for production of this certificate."

A detailed description of the curriculum and equipment of the Institute of Applied Electrotechnics and Mechanics at the University of Toulouse is given in *Le Génie Civil* for April 27. The institute provides a thorough course of training in electrical engineering and applied mechanics, which lasts three (and in some cases four) years. The laboratories, which are equipped in an up-to-date manner, provide both for teaching and research. Special attention is given to hydraulic and internal-combustion engineering. Separate sections are devoted to technical measurements on electrical machines and accessories, static electricity and magnetic measurements, photometry, wireless telegraphy, etc. A special water-tower and auxiliary plant is installed for experiments on water pressure and flow—an innovation that will prove of great value in view of the proposed extension of hydro-electric power in different parts of France.

A delegation of ten distinguished professors from universities of Italy is visiting eight of our universities, namely, Oxford, London (and the Imperial College), Cambridge, Manchester, Leeds, Sheffield, Edinburgh, and Glasgow. The members of the delegation are:—Prof. Volterra, senator, professor of mathematics in the University of Rome; Prof. Archangeli, professor of commercial law in the University of Parma; Prof. L. Bianchi, deputy, professor of psychiatry in the University of Naples; Signor V. Bianchi, deputy, specialist in nervous diseases; Prof. Columba, Rector of the University of Palermo, professor of ancient history; Prof. Credaro, late Minister of Public Instruction, deputy, professor of philosophy in the University of Rome; Prof. Galante, professor of canon law in the University of Bologna; Prof. Giacosa, professor of bio-chemistry and physiology in the University of Turin; Prof. Lori, Rector of the University of Padua, professor of electro-technics, president of the Società per il Progresso delle Scienze; and Prof. Nasini, professor of chemistry in the University of Pisa. Oxford was visited last week, and the visit to London began at University College on Tuesday, when the Vice-Chancellor entertained the delegation at dinner. On Wednesday the Imperial College was visited, and the party lunched with the Lord Mayor at the Mansion House. To-day (Thursday) will be occupied with visits to King's College and Bedford College and a dinner given by the Royal Society of Literature.

The General Education Board, founded by Mr. John D. Rockefeller "to promote education within the United States," will shortly issue its complete annual report for the financial year 1916–17. The grants for that year included the following:—Universities and colleges for whites, for endowment, 237,000*l.*; colleges and schools for whites for current expenses, 2000*l.*; medical education, 270,000*l.*; the education of negroes, 68,607*l.*; professors of secondary education, 6993*l.*; farm demonstration work in Maine (including boys' and girls' clubs), 4300*l.*; farm demonstration work in New Hampshire (including boys' and girls' clubs), 3000*l.*; educational investigation and research, 10,200*l.*; consolidated rural schools, 2000*l.*; experimental school, 9350*l.*; the total being 628,453*l.* Since its foundation the board has granted to colleges and universities alone the total of 2,724,152*l.*, while those institutions themselves have raised simultaneously 10,026,674*l.* The board's gifts have assisted in increasing the resources of 112 colleges and universities situated in practically every State in the Union. Since its organisation in 1902 the General Education Board has appropriated for all purposes 4,271,500*l.* An important action of the board in the past year has dealt with the establishment of the medical department of the University of Chicago. The General Education Board and the Rockefeller Foundation together contributed 400,000*l.* towards a total of 1,060,000*l.*, which was necessary in order to bring together in a single university medical school institutions and resources valued at almost 3,000,000*l.*

SOCIETIES AND ACADEMIES.

London.

Royal Society, May 9.—Sir J. J. Thomson, president, in the chair.—Major P. A. **MacMahon** and H. B. C. **Darling**: Contribution to the theory of attraction when the force varies as any power of the distance.—Sir George **Greenhill**: Electromagnetic integrals. Starting with Maxwell's M, mutual inductance of two coaxial circular currents, a straightforward integration will lead to the analytical expressions arising in the theory of the ampere-balance current-weigher, described in *Phil. Trans.*, 1907, by Ayrton-Mather-Smith, and the complicated dissections are not necessary, employed by Viriamu Jones, Minchin, and other writers. The elliptic integrals which occur are then reduced to a simple standard form, capable of use with Legendre's tables of the elliptic function; and the quadric transformation is explained geometrically, required to reconcile the conflicting notation of previous treatment. A re-drawing is submitted of Maxwell's figure XVIII of the curves of constant M, employing the co-ordinates of the confocal conics on Weir's chart. The same co-ordinates are applied to a state of uniplanar liquid motion, where they appear appropriate, as well as to Euler's problem of the orbit under two centres of force.—Dr. T. R. **Merton** and Prof. J. W. **Nicholson**: Intensity relations in the spectrum of helium. The paper contains the results of an experimental investigation of the variations in distribution of intensity among the lines of the helium spectrum under various conditions of excitation. The intensities have been examined quantitatively, according to the method described in previous memoirs, at various assigned positions in the cathode dark space and beyond, so that the variations can be determined as definite functions of cathode distance. It is found that the relative intensities of lines in the diffuse series of helium and parhelium remain essentially the same at all distances, but that striking variations occur in other types of series. The results are discussed (1) from the point of view of selective transfer of energy in any one series; (2) in relation to type of series—diffuse, sharp, or principal; and (3) in relation to the relative behaviour of the doublet and single-line spectra. The spectra of mixed gases—hydrogen and helium—have also been studied in the same way, and it has become apparent that the phenomena presented by the presence of a spectroscopic trace of one of the gases are essentially different in character from those presented when the gases are mixed in comparable amounts. The low-pressure spectrum of helium has been investigated quantitatively, and the results have been discussed with special reference to the reproduction in the laboratory of the abnormal intensity relations found in the spectra of the nebulæ. It is shown that the nebular spectrum of helium would be obtained very closely by a combination of the conditions belonging to the condensed discharge and to the low-pressure spectrum.—Dr. S. **Chapman**: The outline of a theory of magnetic storms. The average characteristics of magnetic storms are separated into two parts, depending respectively upon time measured from the commencement of the storm and upon local time. In the former the horizontal force is the element chiefly affected, a brief initial increase being followed by a much larger decrease, extending over several hours. Afterwards, during a period of days, the force slowly returns to its normal value. The local-time changes, after the ordinary diurnal magnetic variations have been removed, are approximately simple sine or cosine waves in all three elements. Their mutual relations in phase, and the dependence of their amplitudes upon latitude, are determined for twelve observatories from the mean of forty storms. The two sets of variations are interpreted in terms of electric current systems circulating in the upper atmosphere (with corresponding earth currents). These, again, are referred to the inductive action of a system of atmospheric motions. These motions are primarily vertical, though the unequal distribution of vertical velocity introduces horizontal movements also. The atmospheric motions are explained as the result of the precipitation of electric particles from the sun into the earth's atmosphere. A depression of the absorbing layer (which becomes ionised) is first produced. This is succeeded by a general upward expansion, due to the mutual repulsion of the particles (which are mainly of one sign of charge) which are entangled in the layer. The stratum in which these actions occur is considered to be above that in which the ordinary diurnal magnetic variations are produced, and the ionisation in the latter layer is attributed to the action of ultra-violet light from the sun.

Zoological Society, May 7.—Prof. E. W. MacBride, vice-president, in the chair.—Dr. B. **Petronievics**: Comparison between the lower jaws of the cynodont reptiles Gomphognathus and Cynognathus.—Miss D. M. A. **Bate**: A new genus of extinct Muscardine rodent from the Balearic Islands.

Royal Meteorological Society, May 15.—Sir Napier Shaw, president, in the chair.—C. E. P. **Brooks**: Continentality and temperature (second paper). The first part of this paper deals with the variation with latitude of the coefficients which give the influence of land on temperature. Land east, land west, and ice are considered separately, and it is found that in the tropics the coefficients are uniformly small. In the temperate regions in winter the effect of land to the east is also small, but land to the west has a well-marked effect in lowering temperature; this effect increases towards the poles. In summer, land both east and west increases temperature. In the second part the temperatures of land and water hemispheres are calculated. The distribution of land and sea at the beginning of the Great Ice age is then reconstructed from geological data, and on applying the formulæ calculated in the first part to this changed distribution, it is found that the temperature must have been lower than the present in different districts by various amounts up to 20° C. in January and 15° C. in July. These changes agree very closely with those required by geologists and palæontologists, and it is further proved that the Glacial period was a necessary consequence of the geographical changes. Finally, a theory of climatic evolution is outlined in accordance with these ideas and the theory of isostasy.—J. E. **Clark** and H. B. **Adames**: Report on the phenological observations in the British Isles during 1917. The persistent winter, scarcely broken over four and a half months from early December, dominated seasonal conditions. The chief practical result of the cold was indirect, the heavy destruction of bird-life favouring tree-blight and caterpillars, the ova of which were preserved by the unbroken cold. In many parts the latter stripped fruit trees and ruined garden greens. So, too, the antler-caterpillar plague in Derbyshire was ascribed mainly to the scarcity of rooks. On the other hand, berries and other fruits suffered little from birds. Other summer broods than garden white grubs were also favoured, especially Vanessidæ, including such rarer forms as the Common and White Admiral. From late July into September the splendid harvest prospects were much marred by rain, wind, and lack of sun. Final results were better than 1916, although grain crops fell some 5 per cent. below the ten-year average in England, rising, however, above elsewhere. As to roots, a warm, dry November more than made up for the cold, wet October; whilst potatoes gave a record crop with 8,600,000 tons off 1,364,000 acres, compared with 5,468,000 tons off 1,134,400 acres in 1916. Tree-fruits, too, gave excellent returns, the August gales proving prejudicial to apples only. Finally, November gave a splendid send-off for the coming year in the exceptionally favoured winter earing of the grain crops. This, as the president, Sir Napier Shaw, has shown, may be counted as half the battle in the prospects for successful harvesting. Table v. of the report gives the yearly floral means for the five chief districts from 1891. That year alone was later than 1917, namely, 9·6 days against 7·6 days after the mean flowering date, May 17·4. Birds and insects in table vi. confirm the lateness of 1917, averaging six days and twelve days behind; whilst table vii., of twenty-four migrants, shows nearly ten days' lag behind a twenty-year mean, 1877–96.

PARIS.

Academy of Sciences, May 6.—M. P. Painlevé in the chair.—P. **Termier**: Contributions to the knowledge of the tectonic of Asturias; Peñas de Careses; the Careses-Fresnedo anticlinal zone.—Th. **Schlœsing**, jun.: Ammonium nitrate as manure. In default of the opportunity of working on the agricultural scale, pot experiments are described, using equal weights of nitrogen as ammonium nitrate and ammonium sulphate, together with a blank experiment without ammonium salt. With maize, the nitrate gave slightly greater yields than with the sulphate. Some suggestions as to the best method of carrying out field experiments are added.—C. **Richet** and L. **Flament**: Urinary secretion troubles after great traumatisms. In seriously wounded cases there is a marked diminution in the urinary secretion and in the production of urea. The urea in eleven cases of mortally wounded fell to 30 per cent. of the normal, whereas in fifteen cases, seriously but not mortally wounded, the urea was 44 per cent. of the normal.—J. **Pérès**: Certain developments in series.—T. **Lalesco**: The application of integral equations to the theory of linear differential equations.—M. T. **Béritch**: An intuitive method for the detection of ordinary maxima and minima.—J. **Andrade**: Some point transformations, and the circle of similitude of two cycles.—R. **Bricard**: Movement with two parameters round a fixed point.—L. **Guillet**: The influence of cadmium on the properties of the copper-zinc alloys. With 60/40 or 70/30 brasses cadmium commences to affect the mechanical properties only when the percentage is 1 per cent. or more. Since commercial zinc rarely contains sufficient cadmium to give 1 per cent. in the brasses made with it, the influence of cadmium has not much industrial importance.—G. **Lincio**: The stibnite and pyrites layer at Su Suergiu, Villasalto, Sardinia.—S. **Stefanescu**: A new method for the study of the phylogeny of mastodons, stegodons, and elephants.—H. **Perrotin**: The propagation of heat in the lower layers of the atmosphere.—P. **Lesage**: Contributions to the study of the germination of the spores of mosses.—E. **Bordage**: Observations on the nuclei of the trophocytes arising from the transformation of striated muscular tissue in insects.—P. **Remlinger**: The action of ether on rabies virus. The brain of a rabbit infected with the virus, after 120 hours' immersion in ether loses its pathogenic power. The brain readily forms an emulsion with physiological water after this treatment with ether, and this emulsion can be injected in large doses into animals without any danger. The immunity against rabies thus conferred appears to be lasting.

BOOKS RECEIVED.

An Enquiry into the Analytical Mechanism of the Internal Ear. By Sir T. Wrightson. With an Appendix on the Anatomy of the Parts Concerned, by Dr. A. Keith. Pp. xi+254+plates ix. (London: Macmillan and Co., Ltd.) 12*s*. 6*d*. net.

Tidal Lands: A Study of Shore Problems. By A. E. Carey and Prof. F. W. Oliver. Pp. xiv+284. (London: Blackie and Son, Ltd.) 12*s*. 6*d*. net.

Applied Optics: The Computation of Optical Systems. Being the "Handbuch der angewandten Optik" of Dr. A. Steinheil and Dr. E. Voit. Translated and edited by J. W. French. Vol. i. Pp. xvii+170. (London: Blackie and Son, Ltd.) 12*s*. 6*d*. net.

Astrographic Catalogue. Hyderabad Section. 1900·0. Vol. i., Measures of Rectangular Co-ordinates and Diameters of 63,436 Star-Images on Plates with Centres in Dec. −17°. Pp. xliii+223. (Edinburgh: Neill and Co., Ltd.) 12 rupees or 16*s*. net.

Plant Physiology. By Prof. V. I. Palladin. Authorised English translation. Edited by Prof. B. E. Livingston. Pp. xxv+320. (Philadelphia: P. Blakiston's Son and Co.)

Flora of the Presidency of Madras. By J. S. Gamble. Part ii. (London: Adlard and Son and West, Newman, Ltd.) 8*s*. net.

The Neurotic Constitution. By Dr. A. Adler. Translated by Drs. B. Glueck and J. E. Lind. Pp. xxiii+456. (London: Kegan Paul and Co., Ltd.) 16*s*. net.

Library of Congress. Report of the Librarian of Congress and Report of the Superintendent of the Library Buildings and Grounds for the Fiscal Year ending June 30, 1917. Pp. 223. (Washington: Government Printing Office.)

A Text-Book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. Vol. v., Carbon and its Allies. By Dr. R. M. Caven. Pp. xxi+468. (London: C. Griffin and Co., Ltd.) 15*s*. net.

Guide to the Insects of Connecticut. Part iii., The Hymenoptera or Wasp-like Insects of Connecticut. Pp. 824. (Hartford, Conn.)

Glossary and Notes on Vertebrate Palæontology. By Rev. S. A. Pelly. Pp. ix+113. (London: Methuen and Co., Ltd.) 5*s*. net.

British Medicine in the War, 1914–1917. Pp. x+138. (London: British Medical Association.) 2*s*. 6*d*.

L'Evolution des Plantes. By Prof. N. Bernard. Pp. xxxii+314. (Paris: F. Alcan.) 3.50 francs.

Sir William Ramsay, K.C.B., F.R.S.: Memorials of his Life and Work. By Sir W. A. Tilden. Pp. xvi+311. (London: Macmillan and Co., Ltd.) 10*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 23.

ROYAL INSTITUTION, at 3.—The Abode of Snow; Its Appearance, Inhabitants, and History: Sir Francis Younghusband.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Some Transient Phenomena in Electrical Supply Systems: Prof. E. W. Marchant.

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 5.30.—Internal Ballistics: Lt.-Col. A. G. Hadcock.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

SATURDAY, MAY 25.

ROYAL INSTITUTION, at 3.—Problems in Bird-Migration: Prof. C. J Patten.

MONDAY, MAY 27.

ARISTOTELIAN SOCIETY, at 8.—The "Modes" of Spinoza and the "Monads" of Leibniz: Prof. G. Dawes Hicks.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Anniversary Meeting.

TUESDAY, MAY 28.

ZOOLOGICAL SOCIETY, at 5.30.—A Case of Hermaphroditism in a Lizard, *Lacerta viridis*: Noel Taylor.—Fresh-water Fish as Food: C. Tate Regan.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Application of Electrical Power to Oilfield Requirements: J. Wilfred Burford.

WEDNESDAY, MAY 29.

ROYAL SOCIETY OF ARTS, at 4.30.—Organic Chemistry in Relation to Industry: Dr. M. O. Forster.

THURSDAY, MAY 30.

ROYAL INSTITUTION, at 3.—The Abode of Snow; its Appearance, Inhabitants, and History: Sir F. Younghusband.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—The Cotton-mill Industry of India: Hon. Sir Dinshaw E. Wacha.

SATURDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—Problems in Bird-migration: Prof. C. J. Patten.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, MAY 30, 1918.

GARDENING: OLD AND NEW.

The Standard Cyclopedia of Horticulture. By L. H. Bailey. In six volumes. Vol. v., P–R. Pp. v+2423–3041+plates. Vol. vi., S–Z and Supplement. Pp. v+3043–3639+plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916–17.) Price 25*s*. net each vol.

THE excellence of Prof. Bailey's "Cyclopedia of Horticulture," the earlier volumes of which have already been noticed in these pages, is maintained in the fifth and sixth volumes, which have now appeared and arrived safely in this country. We can imagine no more interesting or stimulating reading for British horticulturists than the articles on subjects grown by them and also cultivated in America.

The differences of climate between the States and this country are reflected in the different horticultural treatment practised by European and American experts. Thus, in the case of the strawberry we find that in the southern districts of the United States it is the practice to take one crop only and then to discard the plants, whereas in our more moderate climate growers generally take three crops before ploughing up their plantation.

Again, as is to be expected in the case of so American a genus, the grape-bearing species of Vitis are treated of in a far more comprehensive manner than in any British cyclopædia; indeed, we confess to a glad surprise to learn that there are no fewer than thirty-six species of Vitis which bear edible grapes.

Here and there the British horticulturist will notice omissions, as, for example, the failure of the author responsible for the article on tulips to cite among the "literature" the admirable monograph of Mr. Dykes on that genus of plants.

The rapidly growing importance of California as a seed-raising country is strikingly illustrated by the statement in the article "Seed and Seedage" that the seeding acreage under lettuce, onion, and sweet-pea—most popular of flowers in America—is no less than 5000. In addition to these seed crops, America contributes large and increasing quantities of seed of the culinary pea, bean, cabbage, radish, and others; nevertheless, the American imports of garden seed alone are of the annual value of two million dollars.

Among the important genera described in these volumes are Primula, Prunus, Pyrus, Rosa, and Solanum, and each is dealt with in a thorough manner. It is noteworthy that, as admitted in the article on the potato, America, like ourselves, has awakened late to the great importance of this crop; Germany alone of all the great nations seems to have taken advantage of the fact that this plant is the most productive of all cultivated food plants. Whereas half the huge crop raised in Germany is used for food for stock or for commercial purposes, only 1 per cent. of the far smaller crop is similarly employed in America.

The treatment of *Primula sinensis*—that queen of flowers for glass-house cultivation—is too meagre to satisfy the British florist, and none of the chief varieties—so interesting both scientifically and floristically—is mentioned. Nor do we think that Prof. Bailey would concur in the statement with respect to peas (p. 2490): "Left to themselves, the varieties of peas soon lose their characteristics through variation."

Broadly speaking, however, the information provided in the cyclopædia is accurate and comprehensive, and we advise all British horticulturists to provide themselves with a copy. Once they possess it, it will be in constant use.

PRINCIPLES AND METHODS OF SCIENCE TEACHING.

A Text-book in the Principles of Science Teaching. By Prof. G. R. Twiss. Pp. xxvi+486. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 7*s*. 6*d*. net.

THIS book is a treatise on the principles and methods of science teaching in secondary schools, and is intended to serve as a text-book on education in training colleges and as a guide to all who are concerned with science teaching and its organisation. It is a large book of twenty-four compact chapters, each being a veritable mine of information. At the end of each chapter there are valuable lists of reference books and sets of questions for further study, and in the appendices are given a selected list of science books suitable for school libraries, a bibliography for teachers, and a list of scientific periodicals.

In the earlier chapters are set forth the principles which should underlie all science teaching, the meaning of science, the viewpoint of the science teacher, and the educational value of science in discipline and culture. The rest of the book is devoted to the details of the methods of class-teaching in biology, geography, physics, chemistry, and what is known as "general science," and to an elaboration of the design of classrooms and laboratories, with catalogues of furniture, apparatus, and plant.

In his earlier chapters the author emphasises the principles which he holds should form the basis of science teaching. He tells us truly—and it is a fact which, strangely enough, stands more in need of emphasis to-day than at any other time—that "modern science and modern social and industrial life are inseparably linked together, and that each in turn causes the other to advance." There is nothing new in this principle, but its application to education in schools is being rejected, one after another, by educational boards and Government committees the function of which it is to reconstruct education after the war. In America, apparently, the authorities put their faith in the principle. "The science work of the school," says our author, "must be kept in close touch with the doings of everyday life, and especially with the activities that lie nearest to the immediate interests of the boys and girls." This, we believe, is the true democratic principle of education and the mainspring of creative life. At any rate, it is that which the people themselves are asking for, but it is the principle which at the moment is threatened with submersion.

Pure and applied science, the author insists, should not be divorced in the schools, and he has some warnings to give science teachers of the danger of "science laboratory courses," where experiments are mainly designed to verify a law, to demonstrate a fact, to determine the value of a physical constant, or merely to measure something. He is all for allowing theories to wait on practical investigations, and most teachers will now agree.

Two criticisms may be offered. The author, with all his belief in the application of science, does not go the whole way and advocate boldly the teaching of applied science in the school. He would find that such a science course would lead in the early stages at school to the elementary (so-called) scientific theories and to mathematical developments. He seems still content to "illustrate" theory by "practical applications"—which, we submit, is illogical and derogatory. However, the method of illustration is dominant to-day—except where needs must, some science may be taught with a vocational "bias," which seems unnatural, crooked, and non-creative.

Even more serious is the author's silence on what is, after all, the most vital thing in scientific education—the growth and development of the "science outlook" on life—the gospel of science.

AVIATION ENGINES.

Aviation Engines: Design, Construction, Operation, and Repair. By 1st Lieut. V. W. Pagé, Pp. 589. (London: Crosby Lockwood and Son, 1918.) Price 15*s*. net.

THE author expresses the desire in his preface that this book shall prove of use to men in the aviation section of the U.S. Signal Corps and to students who wish to become aviators or aviation mechanicians. The subject is obviously one beset with difficulties and restrictions at the present time; not only is practice changing with bewildering rapidity, but much of the information which it would be most useful to impart it is now impossible to print in any book purchasable by the public. These limitations must in fairness be borne in mind when a book on this subject is reviewed, but there are sections of it to which such considerations do not apply, and which can properly be judged on their merits—as it happens, it is in these sections that the main defects of the book are found to lie.

Lieut. Pagé sets out to provide "a complete practical treatise outlining clearly the elements" of the subject, together with sections on the design, construction, operation, and repair of aviation engines. We do not think, however, that the elements have been either clearly or accurately outlined; on p. 21 work is measured on a time basis, and is identified with power; again, on p. 25, momentum is identified with torque, and on the same page pressure, force, and power are all treated as interchangeable terms. Such confusion must spell disaster to any student desiring to acquire a right knowledge of "the elements," and it is scarcely too much to say that the theoretical section of the book would be best omitted by those who approach the subject for the first time.

The practical part of the book is very much more satisfactory, but overweighted with such irrelevant details as the use and care of files, the use and care of taps and dies, and a section on micrometer calipers and their use. Such details as these are better confined to books on workshop processes, as they are common to all engineering construction. The author has, we notice from certain advertisements included in the volume, already written books—altogether some four or five thousand pages—on such subjects as the modern gasolene automobile; the location of Ford engine troubles made easy; motorcycles, their construction, management, and repair; and like works, and must, we should have thought, have noticed the impossibility of combining reasonable bulk with inclusion of workshop processes. This condition of practical repletion extends also to the discussion, on p. 201, of "why lubrication is necessary," since we find that "proper lubricity of all parts of the mechanism is a very essential factor, upon which the durability and successful operation of the motor-car power plant depends." As this applies equally to the aviation engine (about which the book is written), it is not understood why a reference to the motor-car is required; if this sentence, and certain of its successors, are taken from some book on car engines, it would have been better to edit them in the process.

The book is of interest—and of use—to those who are experienced enough not to be misled by the inexact theory, and can select what is useful from what is not; but as a book for students or young airmen of any sort we much prefer the "Aero-Engines" of Mr. Burls, which is so much in use in our own Flying Service.

H. E. W.

OUR BOOKSHELF.

A Check List of North American Amphibians and Reptiles. By L. Stejneger and T. Barbour. Pp. iv+125. (Cambridge, Mass.: Harvard University Press, 1917.) Price 10*s*. 6*d*. net.

THIS is the third list of the kind issued in America, the earlier being by Cope (1875) and by Yarrow (1882). In the meantime, two monographs have been published by the Smithsonian Institution, viz. Cope's "North American Batrachia" (1889) and the same author's "Crocodilians, Lizards, and Snakes of North America" (1900), which, as Dr. Barbour observes in the Introduction, "are frequently erratic and inaccurate." There was great need of a fresh stock-taking of this rich herpetological fauna, so many striking forms having been added since the publication of Cope's monographs, such as, for instance, *Typhlomolge rathbuni* (Texas), *Ranodon olympicus* (Washington), *Batrachoseps* *major* (S.W. California), *Leurognathus marmorata* (North Carolina), *Typhlotriton spelaeus* (Missouri), *Ascaphus truei* (Washington), *Rana virgatipes* (New Jersey), *Phrynosoma brevicornis* (Texas), *Neoseps reynoldsi* (Florida), *Crotalus willardi* (Arizona).

The new check list "has been prepared generally upon the basis of the American Ornithologists' Union Check List of Birds, and following that example, it has included the species and subspecies which the authors deem valid and of certain occurrence in North America, north of the Rio Grande, and in Lower California, Mexico." The higher groups and genera are in systematic sequence, but the species are in alphabetical order, which is regrettable and surprising on the part of the authors, whose perfect knowledge of the subject should have been imparted by arranging the species according to their relationships; in the larger genera, a subdivision into sections would have been a help to the student, and added greatly to the value of this catalogue.

Notwithstanding the protest raised against the constant changes in the scientific names of genera and species which appeared, over the signatures of so many distinguished zoologists, in this journal ten years ago, the process of "revision" goes on as before, and it is lamentable to notice such substitutions as Eurycea for Spelerpes, Gastrophryne for Engystoma, Coluber for Zamenis, Micrurus for Elaps, etc. G. A. B.

The Photographic Industry of Great Britain, 1918. Pp. 247. (London: British Photographic Manufacturers' Association, Ltd.)

FORTY firms who manufacture photographic goods have banded themselves together as "The British Photographic Manufacturers' Association, Ltd.," for the purpose of extending their export trade by developing to the fullest possible extent friendly business relations with buyers in the Overseas Dominions and in foreign countries. This is the first annual handbook of the association. The important parts of it are printed in English, French, Spanish, and Russian, and many of the members' announcements (or advertisements), which fill the second half of the volume, are also given in the four languages, though some omit the Russian version, and others are content with English and French or English alone. After the list of members comes an article by Mr. G. E. Brown which gives a concise sketch, first of the history of photographic invention, and secondly of the photographic industry of to-day. He shows how British invention and British industry stand in the very foremost position. Indeed, if it were possible to abolish all that originated in this country, there would be very little, if anything, left of photography. The handbook gives a classification of makers under the headings of the goods they offer, registers of trade names and trade marks, and various other data to facilitate international dealings. The secretary of the association will be glad to send a copy of it to any established dealer abroad who does not receive one and applies to him for it.

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 Promotion of Post-graduate Work and Research.

IN the article bearing the well-known initials "W. A. T." in NATURE of May 9 on the above subject, the writer has quoted from a report of the Academic Council to the Senate of the University of London a *summary* of reasons for and against the institution of a new doctoral degree. The report referred to has been approved and adopted by the Senate, and a copy is enclosed for your information. Among the reasons for the establishment of such a degree, the first is:—

"That it would be the means of strengthening the unity of the Empire by increasing the number of students from the universities of the British Empire who pursue their graduate studies in Great Britain."

On this the writer says:—

"Of all these considerations [*i.e.* the reasons in the summary] it appears to the writer that the first is, at the present time and probably for generations to come, of greatly preponderant importance. And in declining the proposals which come to it from his Majesty's Dominions beyond the seas, the Senate has missed a great opportunity for the development of the University."

The proposals as formulated by the President of the University of Toronto in a letter dated April 30, 1917, are as follows:—

"It will be necessary for the universities of Britain to establish some doctor's degree which will be within reach of our best students who hold our preliminary degree, provided they are required to spend not more than three years in Britain in order to obtain it."

A student coming from a foreign or Colonial university immediately after graduation can enter for the M.Sc. examination after pursuing an approved course as an internal student of the University of London extending over not less than two years. If successful, further attendance at a prescribed course of study will not be required. It is possible for him to return home to continue his studies, and to present a thesis for the D.Sc. degree after the prescribed interval of time. On the other hand, if he continues his studies abroad for two years after taking his preliminary degree and produces work of sufficient merit, he may be excused the M.Sc. examination and allowed to proceed to the D.Sc. examination after a period of study as an internal student of the University of London of not less than two years. The provision that four years must elapse between the date of the examination, in virtue of which he is registered, and the date of his D.Sc. examination can be shortened in exceptional cases.

It would appear from the above that, although the Senate has not instituted a new degree, the opportunities for overseas students to carry on research and to proceed to higher degrees in the University of London are ample.

The main reason for declining to establish a new degree is that it would damage the standard of the existing doctorates. The writer's estimate of that standard as set out in his article is not flattering. If it is accurate, there is no case for the establishment of a doctorate of a lower standard.

One of the resolutions passed by the Conference of Universities of the United Kingdom, held on May 18, 1917, was as follows:—

"The existing doctorates of the home universities should, if possible, be maintained, and their present standard should not be lowered."

The words "if possible" in this resolution seem to give away the case, and justify the Senate in the action it has taken.

In the paragraph of the article immediately following that from which I have already quoted the writer destroys the argument as to the extreme importance of the establishment of the new degree. He says that "university professorships will be filled everywhere by men who have shown by their work and teaching that they are qualified and eager to advance knowledge in their respective subjects, and the abler students will go to the abler teachers. . . . Degrees have very little to do with the matter."

This is the heart of the matter, and is exactly what is implied in the second reason given by the Academic Council against the establishment of a new degree, namely, that "the abler students come to London on account of the facilities for study, and not primarily to get an English degree." If the writer of the article will read over again the documents in support of the *summary* of reasons given by the Academic Council for and against the establishment of the new degree, he will find in the report of the Imperial Studies Committee that emphasis is laid on "the opportunities of work under English scholars of international reputation." These opportunities are included in the facilities for study, which, in the opinion of the Academic Council, do not consist wholly of "museums, libraries, and laboratories."

It should be borne in mind that the conclusions of the Academic Council are in entire accordance with the opinion of the members of the Imperial Studies Committee, of which the chairman is Lord Bryce, and which includes many members who are not only acquainted with the academic point of view, but also able to bring to bear on this matter their varied experience of public affairs. M. J. M. Hill.

University College, London, W.C.1, May 14.

Having already expressed my view in the article which is criticised by Prof. Hill, I can only add that America and Canada have asked for one thing, and the University of London, in response to their demand, has offered another. Which of the two parties is supported by the more cogent reasons for its action is a matter of opinion. Mine has been already sufficiently expressed, and I am supported by the belief that it is shared by others who are more intimate with the feelings and conditions which led to the original request from overseas. W. A. T.

May 18.

Proposed Society of Science Students.

For some time past we have had in mind the desirability of the existence of a society of young scientific students for mutual help. There are no doubt many enthusiastic students of science who, like ourselves, have to rely chiefly on their own efforts for their progress in science, and we think that it would be of great advantage to them if they could co-operate in such matters as the purchase of apparatus, materials, and books, and combine for mutual help. There is no society which fully provides for these, and we have decided, after careful consideration, to endeavour to try to get into touch with some of this class of students through the columns of Nature. Will those students who are interested in the subject please communicate with Mr. P. E. Owens, 28 Jesse Terrace, Castle Hill, Reading? J. A. Butler.
P. E. Owens.

CLOUDS AT THE ROYAL ACADEMY.

The smoke and haze which commonly obscure the sky in large cities, and the otherwise restricted outlook, allow the town dweller inadequate opportunities for the study of clouds, but to those who live in the country, and to the observant worker in a town when spending a holiday away from his native place, the ever-varying cloud effects form quite as attractive an object of interest as the countryside itself. This being so, it might be thought that in landscape scenes artists would devote at least as much attention to the sky and the clouds above as to the hills and valleys below. That this is not the case will be painfully evident to the meteorologist, or even to the ordinary intelligent observer of Nature who visits the Royal Academy and makes but a cursory examination of its walls. Let it be granted at once that there are notable exceptions, but the conclusion cannot be resisted that to many artists the clouds form a very subsidiary part of the picture, and are put in to produce what to the artist's eye is presumably a pleasing effect, but without the least regard to natural truth.

The majority of the clouds appearing in this year's exhibition belong to the strato-cumulus or fracto-cumulus type, though, as would be expected, the hard convection cumulus, the most striking of all clouds, is not neglected. Perhaps the most remarkable feature is the almost entire neglect of high clouds of the cirrus and cirro-cumulus types, which produce some of the most beautiful effects in Nature. Cirro-cumulus is shown in one or two sunset pictures, and a not entirely successful attempt has been made in one case to depict the sun shining feebly through an alto-stratus veil; but true cirrus is almost entirely unrepresented. In "The Passing of Autumn" (91) the meteorologist may think that he detects a fragment of false cirrus showing up against a rather fine cumulus, but the remaining clouds in this picture spoil what might otherwise have been a successful cloud study. True cumulus should surely be a cloud type which would lend itself to the artist's needs without any departure from the forms provided by Nature; but in many cases these clouds are given the most grotesque and unreal shapes, which completely spoil the picture to the observant lover of the country. On the other hand, some of the most successful clouds in the exhibition appear in B. W. Leader's "The Weald of Surrey" (51) and A. R. Quinton's "The Road over the Downs, Sussex" (695), where clouds of the cumulus and strato-cumulus types are both true to Nature and blend admirably with the peaceful scenes depicted. Less peaceful, but with an equally admirable effect, is A. W. Parsons's "Rolling from the West" (196), where similar clouds are depicted over the sea. In the most prominent picture of the second gallery, "Cader Idris" (87), H. Hughes-Stanton includes clouds of the cumulus type which, in their hard outlines and rather unnatural colouring, are very jarring when inspected from any of the nearer parts of the room; but if the picture is viewed from the greatest distance possible the effect becomes more attractive, and the lights and shadows of the clouds blend into one another in a more harmonious whole. A very similar effect is produced in the smaller work by the same artist, "Welsh Hills near Barmouth" (602).

When looking at a wide stretch of country, whether it be an extensive plain as seen from the top of a range of hills, or the hills and valleys of a mountainous country viewed from some vantage point, the most attractive effects are often obtained on a day when the sky is covered with detached clouds of the cumulus type, causing a bright contrast between the light and shade on the country below. A scene of this kind is depicted by Bertram Priestman in "The Walls of Langstrothdale" (114), but to the critical observer the whole is spoilt by the unreality of the clouds themselves, though the shadow effect on the ground is more successful. The only type of cloud which is almost uniformly well dealt with is where the "clouds" appear as mountain mists, and one concludes that artists must subject this type to much more study than the clouds in the sky above. Some of these mountain mist effects are notably good. "The Head of the Glen," by Peter Graham (439), and "Yarrow: 'The Vapours Linger Round the Heights,'" by Alfred Parsons (126), may be mentioned amongst others in this connection. In "Easedale Tarn, Westmorland" (207), J. H. Crossland has shown us clouds over a mountain-top which are delightfully real. Attempts to indicate showers passing over a landscape generally lead to a more successful portrayal of the dark falling rain in the shower than of the cumulo-nimbus cloud above. This appears to be a subject that might give far more realistic and attractive results than any shown in this year's exhibition. "The Gravel Pit," by Arthur Friedenson (583), seems to be the most successful of those exhibited. The high cloud at sunset in B. W. Leader's "Still Evening" (175) raises an interesting speculation as to the probability of the conditions shown being true to life. Bands of high cloud are brightly tinted pink in the rays of the setting sun, whereas other clouds in the same part of the sky, but at an apparently higher level, are illuminated, but without colour. The writer does not remember a case of this kind coming under his observation, although it appears not to be impossible. The interesting and quite common case where the high clouds are illuminated with a pink glow, while the lower ones have already passed into the shadow of the earth, does not seem to have attracted the artist's imagination. Very interesting information as to the relative heights of different cloud layers may sometimes be obtained in these circumstances.

Observers often, in dealing with Nature herself, have difficulty in deciding to which of the artificial types of the international classification a cloud belongs, so infinite are the varieties which occur, but all meteorological observers who visit the Academy will undoubtedly give a sigh of relief that they are not expected to classify the strange shapes which appear in the sky in "Evening" (233), to mention one case only, though it does not stand alone. In "Wind from the South" (383) the artist presumably set out to portray falling snow; but surely with a title so meteorological he might have given more careful attention to the meteorological elements in his picture. Finally, all who hold that gunfire has an influence on rainfall should undoubtedly visit the Academy for confirmation of their views. If the clouds over the battlefields of France really take the forms shown in some of the pictures (notably "Dawn," 333), few will have the hardihood to maintain that the rainfall or even the entire climatic conditions of the neighbourhood may not be seriously affected.

J. S. D.

THE CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND.

A FEW months ago (NATURE, January 10, p. 369) attention was directed to a report of a special committee appointed by the British Science Guild and published in the journal of the Guild for December last. The report discussed the manner in which the trustees of the Carnegie Trust for the Universities of Scotland were carrying out their purpose of strengthening and developing scientific research, a question which was raised by Prof. Soddy in *Science Progress* for January, 1917. The recent issue of the sixteenth annual report of the Carnegie Trust seems to call for some further comment in connection with the criticisms then advanced.

The report shows how the grants have been distributed during the year 1916–17. Since this is the fourth year of the third quinquennial period, no vital changes in the general character of the report are to be expected. A new feature is the list of the trustees and the members of the executive committee, which is printed on the back of the title-page. When it is borne in mind that one of the main purposes of the Carnegie Trust is to improve and extend the opportunities for scientific study and research, it is matter for some surprise that of the twenty trustees four only can be regarded as men of science with direct knowledge of the meaning and methods of research. There is improvement, however; for originally there were only two, and for a short interval none, who could be ranked as men of science.

As regards distribution of grants under Clause A of the trust deed, the present war conditions have naturally had important effects. Large sums granted towards the cost of new buildings have not been expended. In the case of the Universities of Glasgow and Aberdeen these sums are simply held over; but in the case of Edinburgh a sum of 31,000*l.*, originally allocated over the five years for buildings and permanent equipment in chemistry and anatomy, has been diverted for the endowment of a professorship of chemistry in relation to medicine, a professorship of French, and two new lectureships, one in Italian and one in Spanish. The institution of a separate chair for chemistry in medicine may be expected to make possible a fuller development of the original chair as a centre of scientific research, and the University of Edinburgh is to be congratulated on having given a useful lead in this much-needed reorganisation of the chemistry department.

Arranging under general groups the sums expended during the year 1916–17, and taking into account the change in the allocation for the University of Edinburgh, we find that 43 per cent. was applied towards providing new buildings and permanent equipment in arts, medicine, and science, 36 per cent. towards endowment of professorships and lectureships in these three faculties and for other general purposes, 9 per cent. towards books, etc., for libraries, and 12 per cent. towards the direct endowment of research in science, medicine, and history—where under history are included also archæology, economics, modern languages, and literature. It may be mentioned that fully half the sum was allocated to the history group, so that only 6 per cent. of the grants for the year were used in the encouragement of research in modern progressive science.

It must be recognised that under present war conditions scientific research by young graduates is practically impossible; but the fact remains that in the present quinquennial scheme, which was inaugurated nine months before the outbreak of war, direct endowment of scientific research did not form a very conspicuous feature. On the other hand, it may be argued that it is not an easy matter to supply money directly for research unless the purpose of the research is clearly recognised. Post-graduate work by Carnegie scholars and fellows may or may not yield important gains in increasing or systematising scientific knowledge. A trust like the Carnegie Trust for the Universities of Scotland may have good reasons for believing that the interests of scientific research may be best advanced in the meantime by providing better laboratories, increased equipment, and more efficient teaching, in the hope that other good things will follow in their train. In any case the trust has a grave responsibility, and must see to it that there is no chance of wasteful squandering of the funds it has to administer.

THE RELATIONS OF GEODESY TO GEOLOGY.[1]

THE study of the earth is the aim of both geologists and geodesists, but their methods of investigation differ so widely that their cooperation is sometimes difficult to bring about. While the geologist utilises descriptions and measurements which he has collected at many places widely distributed over the earth's surface, the geodesist deals with a comparatively limited number of observations carried out with the aid of instruments of high precision, and carefully corrected for all ascertainable errors; his material for discussion is provided from data the magnitudes of which are very small, and the weight and relevance of which are not readily appreciated by workers whose advance is along other lines. Still, the co-operation of geology and geodesy is very desirable, and the work that has been done during the past ten or fifteen years in India, where the most extensive collection of high-grade geodetic material in the Empire is available, in bringing together these two lines of investigation may lead, we hope, to further work both there and elsewhere. The reports of the Geodetic Survey of South Africa furnished some similar material, and Dr. W. Bahn, in an article which appeared in the *Beiträge für Geophysik* of 1910, discussed the geodetic results and indicated their bearing on the tectonic geology of the area; but such discussions have been few.

The Himalaya problem is dealt with in the present memoir by Mr. Oldham, who aims at adding to the stock of fundamental facts and so utilising the work of Col. Sir Sidney Burrard, Dr. Hayden, and others that a theory may be built up such as will adequately account for the conditions revealed by geodetic and geological observations.

The following conclusions are quoted as obtaining general acceptance, and as, therefore, providing a starting point for discussion. The elevation of the Himalayas has been accompanied by compression of the rocks of which they are composed; a great main boundary fault lies along the outer edge of the Himalayas, and separates the rocks of the northern area from the Upper Tertiary rocks of the southern area; a series of similar faults is found within the Siwalik area, and these are regarded as marking progressive shifts southwards of the boundary of uplift to the north and deposition to the south.

The discussion is introduced by a chapter which is devoted to an explanation of the nature of the geodetic evidence in which the theories of compensation and isostasy are discussed. A short but useful account of compensation from the work of Archdeacon Pratt and Sir George Airy to the recent studies of Hayford, Bowie, and others leads up to the development of tables of compensation factors for various distances and depths.

The geodesist does not determine the absolute value of the deflection of the plumb-line from the vertical, and selects a station as origin to which he refers the results obtained at other stations. For India the station of Kalianpur has been taken as origin with the assumption that no deflection exists there; but as the existence of a southerly deflection has been established, a correction for the amount of it has to be applied generally before the results at other stations can be employed. Variations in the force of gravity are determined by comparing the period of a free-swinging pendulum at different stations when all the necessary corrections have been applied. These local values have then to be compared with the normal value for that point on the earth's surface, and to do

[1] "The Structure of the Himalayas and of the Gangetic Plain as Elucidated by Geodetic Observations in India." By R. D. Oldham. "Memoirs Geol. Survey of India," vol. xlii., part 2, 1917.

this it is necessary to reduce the local observed value to sea-level. This involves an estimation of the masses of the earth above sea-level, both above and below station-level, in order that their effect may be correctly allowed for.

Mr. Oldham first takes the case of an imaginary mountain range agreeing approximately in its dimensions with the Himalayas, but more regular in form, consisting of a plateau of 15,000 ft. altitude, from which an incline of 100 miles in breadth descends to 5000 ft. by a series of steps, and terminates in another plateau at an altitude of 1500 ft., and 20 miles broad, bounding the Gangetic trough on the north.

Utilising this imaginary range, the effects of various hypotheses of compensation are considered, and the deflections at a series of points on a line crossing the range are computed and tabulated. The attractions of the visible masses, both compensated and uncompensated, are compared, and also the topography of the imaginary range and the actual topography, as determined by Major Crosthwaite, R.E. The Siwalik Hills, with their lower density of about 2·2, as compared with the 2·7 of the Himalayas, are separately taken into account. The case of uniform compensation to different depths is examined and compared with the results given on the assumption of a variable compensation.

Passing from the hill range to the Gangetic trough, reasons are given for taking the value 2·16 for the density of its filling material, and on this assumption the deflections due to such a trough of various depths, breadths, and sectional forms are computed and compared. All this forms a standard of comparison for estimating the value of the observational material, and the geodetic data along lines traversing the Gangetic trough are next examined, the conclusion being reached that the maximum depth of the trough need not exceed 25,000 ft., and can scarcely be less than 20,000 ft., according to the deflection observations. The gravity observations are next discussed and are considered to bear out generally the conclusions which had been reached on the deflection data and to indicate a general upward slope of the floor of the Gangetic trough towards the south. Special cases at Dehra Dun, in the Punjab, etc., are discussed in fuller detail, and near the Siwalik Hills a maximum depth of at least 10,000 ft. for the trough is highly probable.

The next stage in the investigation is a discussion of the support of the Himalayas, and taking the Himalayan geodetic stations, the probable and actual deflections are compared. Local topographical irregularities introduce difficulties in some cases, but there is in all three regions examined an excess of observed over calculated deflection in a northerly direction. Neither alteration in the depth to which compensation extends nor the adoption of a hypothesis of flotation provides an explanation, but the author would attribute it to departures from locally complete compensation. The observations of M. de Filippi's expedition to the Himalayan region should add valuable material for this inquiry, but at present there seems to be a defect of gravity as the hills are entered.

This memoir is a valuable addition to geophysical literature, and a useful contribution to the study of a difficult problem which will be welcomed both by geologists and geodesists. It is to be regretted that the illustrations are poor specimens of such work, for there should be no difficulty in providing more satisfactory blocks. The omission of an indication of the units employed in several of the tables is tiresome to the reader.

H. G. L.

CLIMATOLOGY AND AN ABANDONED FLYING SCHOOL.

THE *Times* of May 20 contains a summary of the third report of the Select Committee on National Expenditure, which gives the material facts about the abortive scheme of the War Office to establish at Loch Doon, Ayrshire, a large school for the training of airmen in gunnery. It is a striking and very expensive example of that incoherence or lack of co-ordination under stress against which the discipline of science as a part of education should be our safeguard. In 1916 the Air Board wanted an aerodrome for special purposes, and found a site at Loch Doon which would fulfil their requirements provided that a peat-bog on the western side of the lake could be drained and certain engineering work carried out on the eastern side. Taken independently, both these conditions could be satisfied, and operations were set on foot. By May, 1917, the estimated cost was 350,000*l.*; afterwards, large further sums were being asked for to complete the scheme; but, though each item had been separately satisfied, the object was not achieved. The climatic conditions were quite unsuitable for a training school, the local "bumps" were a great drawback for the special purpose of the aerodrome, the conditions of the surrounding area placed intolerable restrictions upon its use, and, on account of the increased speed of flight, the engineering works were already out of date. In January, 1918, the Air Council decided to cut the loss and abandon the scheme.

Looking back at the evolution of this fiasco, various points are evident. The air authorities apparently worked by the map, the engineers considered only the questions of draining a bog and constructing certain railways, hangars, etc., not the making of an aerodrome; and the vexatious details of the climate of the British Isles were left to express themselves in their own inexorable way when the mechanical operations had been provided for. The last is, perhaps, the most instructive feature of the situation. Climatology is the science which uses the common experience of past weather to safeguard the future of all operations that depend upon weather. Its basis of fact is merely organised public memory. The Meteorological Committee, in its reports, has frequently urged that, in the public interest, local authorities should keep suitable records. If this course had been followed in Ayrshire, some 500,000*l.* might have been saved. But our local authorities have not yet acknowledged the duty.

It has been left to the meteorological societies, or the Meteorological Office, or the British Rainfall Organisation to collect such observations of weather as are made for country landowners or by meteorological enthusiasts in various localities; the distribution is naturally haphazard. Moreover, with the possible exception of the water engineer, the people who have to carry out such schemes have no training in the use of the collected information or in how to find it, and without some experience the tables are difficult to use. Much of the information requires re-working in order to answer special questions. For those who know where to look for it, there is a vast mine of information about the climatology of the British Isles, but, for lack of schools devoted to such sciences, it is largely unworked. An authoritative compilation is much needed. The Royal Meteorological Society, in co-operation with the Meteorological Office, began to work the data for a climatological atlas shortly before the war, but has had to discontinue the task for the present. It was thought at the time to be an undertaking of great utility, but that its present worth might run to six figures in a single case was clearly not realised.

NOTES.

THE twelfth annual meeting of the British Science Guild will be held at the Mansion House on Wednesday, June 19, at 4 p.m., the Lord Mayor in the chair. Lord Sydenham, president of the guild, will deliver an address on "Education, Science, and Leadership"; and other speakers will be Sir Algernon Firth, Bart., and Sir Henry Newbolt. Tickets of admission may be obtained from the Secretary, British Science Guild, 199 Piccadilly, London, W.1.

THE Lords Commissioners of H.M. Treasury have approved the proposal of the Meteorological Committee that, in view of the variety and importance of the scientific problems upon which the Meteorological Office is required to advise the fighting forces, Sir Napier Shaw shall, for the period of the war, become scientific adviser to His Majesty's Government in meteorology, and be relieved of the administrative duties of the Meteorological Office, but retain the chairmanship of the Meteorological Committee. Lt.-Col. H. G. Lyons, with the sanction of the War Office, has been appointed acting director of the Meteorological Office for the same period. We most heartily congratulate the Government and Sir Napier Shaw upon this appointment. Meteorology in England has made great progress during the last twenty years, and a large share of the credit for this must be given to Sir Napier's administration of the Meteorological Office and to his lectures and papers on the subject. The value in war of correct forecasts is obvious, but there are many other ways in which an intimate knowledge of meteorology may be of use, and no more suitable man could have been found for the new post.

THE return to Copenhagen from Greenland, *via* the Faröe Islands, of Mr. Knud Rasmussen, the Danish Arctic explorer, is announced by Reuter's Agency. In 1916 Mr. Rasmussen explored the coasts of Melville Bay between Upernivik and Cape York, as ice prevented his reaching his station at Thule, in North Star Bay. In 1917 he returned to his original programme of exploring the north-west coast of Greenland, with special reference to Eskimo migrations. This was almost the last unexplored part of the Greenland coast. The expedition also planned to carry mails to the American Crocker Land Expedition and its relief expedition, the latter supposed then to be at North Star Bay, south of Smith Sound. The news now to hand through a Reuter message reports that Mr. Rasmussen reached Sherard Osborne Fjord early in May, 1917, and spent the summer in mapping the little-known fjords as far north as De Long Fjord. The difficulties of travelling were accentuated by the absence of game. In the beginning of August the expedition started south again over the ice, and with great difficulty reached Cape Agassiz, 140 miles north of Etah, in three weeks' time, and Etah on September 10. Dr. Wulff, one of the men of science, died of exposure. Mr. Rasmussen apparently wintered at Etah or Thule, and left Greenland this spring. He reports no trace of Eskimo migrations on the north-west coast. Apparently his plans for traversing the Canadian Arctic archipelago from east to west have been deferred.

SCIENCE has lost another distinguished young votary by the death of Capt. James Watson Pryde, who fell in action in East Africa on May 5. Capt. Pryde was a native of Dundee, and received his early education at the Morgan Academy. He then entered the University of St. Andrews, and completed his arts course with distinction in every class. With a strong bent for science, he selected zoology as his main department, and there he gained the highest honours in class and degree examinations, as well as in practical work. Moreover, he at once commenced, as Walker Trust scholar, original work at the Gatty Marine Laboratory, taking up the study of the North Sea Polychæts where another able graduate, Wm. Small, now with the fighting forces in East Africa, had left off, and his published papers show that he did so with conspicuous success. Early in his college career Pryde joined the O.T.C., and at the outbreak of the war was sergeant-major. He volunteered for service at once, and received a commission in the Black Watch, his talents, administrative skill, and agreeable bearing making him very popular. He was then attached to the King's African Rifles, and lately was at Zomba, Nyasaland, pursuing the Germans into Portuguese East Africa, in the region of the Lugenda River. He was looking forward to an early return to continue his researches and the study of medicine. The loss of a zoologist so able and accomplished, and of so gallant a soldier, is grievous.

THE Trustees of the British Museum have published a report on an investigation carried out by Mr. J. Hartley Durrant, of the Natural History Museum, and Col. W. W. O. Beveridge to ascertain how and when the infestation of Army biscuits by flour-moths takes place, and whether any steps can be taken to prevent this. A list is given of eight species of beetles and four Pyralid moths that were actually found in the tins of biscuits examined. But by far the most serious pest was the moth *Ephestia kühniella*, and excellent illustrations and a full description are given both of this species and of *Corcyra cephalonica*. Evidence is adduced indicating that Central America is probably the original home of *E. kühniella*, the so-called Mediterranean flour-moth. The examination of various intact airtight tins showed that the biscuits contained in them were infested, thus indicating that the moths had gained access to them in the factory prior to packing. By means of a thermo-couple the temperature in the centre of the biscuits during baking was tested, and found to rise to a minimum of just above 100° C. It is considered improbable that insect-eggs, if present in the dough, could survive this temperature. The infestation of the biscuits must take place, therefore, during the cooling and prior to the tins being soldered. The authors suggest that a strong draught of screened cooled air should be passed over the biscuits immediately they have been baked; this would cool them more rapidly, and render it practically impossible for the moths to oviposit on them. Further, the packed tins might be punctured, heated to a lethal temperature, and then soldered up; but against this there are certain technical difficulties, and also the question of expense.

MR. D'ARCY POWER has been appointed Bradshaw lecturer of the Royal College of Surgeons of England for the ensuing year.

THE Royal Society's Croonian lecture will be delivered by Major W. B. Cannon on Thursday, June 20, the subject being "The Physiological Basis of Thirst."

THE Bathgate memorial prize of the Royal College of Surgeons of Edinburgh, consisting of a bronze medal and books, has been awarded to Miss J. A. Sang.

THE medal of the Franklin Institute, Philadelphia, has been awarded to Senator G. Marconi and Dr. T. C. Mendenhall. The presentations were made at the meeting of the institute on May 15.

AT the ordinary scientific meeting of the Chemical Society to be held on Thursday, June 6, Dr. Horace T. Brown will deliver a lecture entitled "The Principles of Diffusion: Their Analogies and Applications."

SIR JAMES DEWAR has been awarded the medal of the Society of Chemical Industry in recognition of the conspicuous services which, by his research work in both pure and applied science, he has rendered to chemical industry.

THE seventieth annual general meeting of the Somersetshire Archæological and Natural History Society will be held in the Municipal Hall, Taunton, on Tuesday, July 23, under the presidency of Prof. F. J. Haverfield, who will deliver a short address on "The Character of the Roman Empire as Seen in West Somerset."

THE eighth geophysical discussion arranged by the British Association Geophysical Committee will be held at the Royal Astronomical Society on Wednesday, June 12, at 5 p.m., Rear-Admiral J. F. Parry, Hydrographer of the Navy, in the chair. The subject will be "The Tides," and the opener will be Prof. H. Lamb, who will be followed by Prof. Love, Mr. Proudman, and others.

THE following officers and new members of council of the Institution of Electrical Engineers have been elected for the ensuing year:—*President:* Mr. C. H. Wordingham. *Vice-Presidents:* Mr. W. A. Chamen, Mr. R. A. Chattock. *Hon. Treasurer:* Mr. J. E. Kingsbury. *Ordinary Members of Council:* Mr. H. W. Clothier, Mr. D. N. Dunlop, Sir R. A. Hadfield, Bart., Prof. E. W. Marchant, Mr. C. C. Paterson, and Mr. J. Sayers.

THE officers of the Linnean Society elected for the ensuing year are:—*President:* Sir David Prain. *Treasurer:* Mr. H. W. Monckton. *Secretaries:* Dr. B. Daydon Jackson, Mr. E. S. Goodrich, Dr. A. B. Rendle. The new members of council are:—Mr. S. Edwards, Prof. J. B. Farmer, Mr. C. C. Lacaita, Mr. R. Innes Pocock, and Miss A. Lorrain Smith.

THE *British Medical Journal* announces the death on March 3, at sixty-six years of age, of Prof. C. Blarez, professor of chemistry in the University of Bordeaux. We learn that Prof. Blarez published more than two hundred memoirs on pure or applied chemistry, and was the author of a course of organic chemistry in three volumes, and of monographs on the urine and on milk. His last publication was a treatise on wines and spirits embodying the results of forty years' work.

A STRONG earthquake visited La Serena, the capital of the province of Coquimbo, in Chile, at 1 p.m. on May 20, but the damage to the town seems, according to the telegram of the *Times* correspondent, to have resulted from fires rather than from the shock itself. The disturbed area was of considerable extent, the shock being felt at Valparaiso, about 210 miles, and Santiago, about 250 miles, to the south of La Serena. As a seismic district the province of Coquimbo is one of the most sensitive in Chile, but there is nothing in the brief account to indicate that the recent earthquake was of unusual severity.

WE regret to learn of the death of Prof. Victor Commont, of the Normal School at Amiens, in his fifty-second year. Prof. Commont was an accomplished geologist and anthropologist who devoted the leisure of a busy life to the detailed study of the river deposits in the valley of the Somme, where Boucher de Perthes first brought Palæolithic implements to the notice of the scientific world. Prof. Commont's researches added precision to the earlier work, and his classic papers on the succession of implement-bearing deposits in the Somme valley form models to be followed wherever similar investigations are undertaken. In the neighbourhood of Amiens he identified deposits of all periods from that of the earliest Palæolithic man to that of the Iron age, and in numerous sections he clearly discovered their relationships. He also devoted much attention to the implements themselves, and had an unrivalled knowledge of the successive types. In 1913 Prof. Commont visited London to examine some of the typical localities in the Thames valley, and to study the newly found collection from Piltdown, Sussex. His premature death is indeed a serious loss to prehistoric research.

IN the Journal of the Royal Anthropological Institute (vol. xlvii., July–December, 1917) Mr. Sidney Ray contributes an elaborate article on "The People and Language of Lifu, Loyalty Islands." Capt. Cook missed the islands of the Loyalty group when he discovered New Caledonia in 1774, as did D'Entrecasteaux in 1793. Missionary work has gone on since 1840 in Maré, and since 1845 in Lifu, but since the annexation of the Loyalty Islands by France in 1864 there has been trouble with missionaries of the Protestant Church, and at present there is only one English missionary in the island. Mr. Ray's paper gives a series of glossaries and notes on the culture of the inhabitants. The use of a ceremonious language employed when addressing or referring to a person of high rank is an interesting and peculiar custom in Lifu and Nengone, but is strangely absent in the neighbouring island of Uvea.

DR. WALTER COLLINGE, in the *Scottish Naturalist* for May, directs attention to the very unsatisfactory methods commonly in use by economic ornithologists for estimating the food contents of the stomach or crop, as the case may be, in wild birds, for the purpose of determining the usefulness or otherwise of any given species to the farmer or gardener. Briefly, he shows that the volumetric standard adopted by the Biological Survey of the U.S. Department of Agriculture affords the only trustworthy source of information, and should become, indeed, the only recognised test. Each bird requires a certain bulk of food per day, not a certain number of different kinds of insects, seeds, etc., and rightly to estimate the importance of any element in its diet we must first know what proportion the insects, seeds, and so on constitute to the standard requirement. Two very helpful diagrams illustrate the paper.

How little the true nature of museum work is understood, even by many men of science, forms the subject of a very able essay by Dr. F. A. Bather in the *Museum Journal* for May. It seems incredible, for example, that a well-known British zoologist was recently found to believe that the specimens in the public gallery represented the whole collection of fishes in the British Museum of Natural History! After citing instances of the work done by museums in unravelling intricate problems, such as that presented by the attacks of beetle-larvæ on the roots of the sugar-canes in Mauritius, Dr. Bather proceeds to show the imperative need for the most refined, systematic study of living organisms, irrespective of any value they may have in relation to "applied science." This is the most valuable part of his essay, as it was meant to be, though we fear that the day is yet far distant when the general public will realise that science for its own sake is worth pursuing.

THE Geological Survey of Queensland is to be congratulated on the progress it is making in publishing accounts of the fossils of that colony. The two concluding sections of part i. of Mr. A. B. Walkom's memoir on the Mesozoic floras of Queensland are especially interesting for comparison with the Jurassic and Rhætic floras of Europe, which they much resemble. In Publication No. 260 Mr. R. Etheridge, jun., describes some important fossil invertebrata, including Cretaceous crustaceans and a few fragments of the largest known Carboniferous trilobite, which measured about 60 mm. in breadth.

THERE is remarkable uniformity in the anatomy of flesh-eating dinosaurs of Mesozoic times, whether they are early or late, small or gigantic. They all have large hindquarters for bipedal walking, a long tail, very small mobile fore-limbs, and a more or less regular series of sabre-shaped teeth. Mr. Lawrence M. Lambe has just published a well-illustrated description of another genus, Gorgosaurus, from the Cretaceous rocks of Alberta, Canada (Geological Survey of Canada, Memoir 100). Its typical species is about 30 ft. in length, and is specially interesting as one of the latest carnivorous dinosaurs known. There is little new in the skeleton, but the fore-limbs seem to be even more reduced than usual.

THE subject of soil aeration is attracting considerable attention in tropical agriculture, and numerous results are now being obtained, a summary of which was presented by Messrs. A. Howard and R. S. Hole to the Indian Science Congress at Lahore. The effect of adding potsherds or sand to the Pusa soil is shown to increase nitrification and plant growth; in the case of Java indigo the increase was as much as 40 per cent. Flood irrigation, on the other hand, on fine alluvial soils, interferes with their ventilation by rapidly destroying the texture and by forming a compact surface crust impermeable to air. One limiting factor—water—is removed, but another—the need for aeration—is introduced. Thus over-irrigation actually diminishes the yield. This is shown by results obtained at Quetta, where thirteen maunds of wheat were obtained with one irrigation and only eight maunds where three irrigations were given. In any flood irrigation system a practical compromise between the needs of the plant for air and for water must be worked out. This has been accomplished at Quetta by the proper utilisation of the preliminary watering given before sowing. Under this new system the yields are often higher than those obtained with the six or seven waterings usually applied. The Quetta results have been shown by experiment to apply to the Punjab and Sind, where almost half the irrigation water now used could be saved. The economic significance of these results becomes apparent when it is remembered that the annual revenue derived from irrigation works in India is 5,000,000*l.* sterling. It is further shown that aeration probably influences the distribution of plants, and is therefore of importance in ecological studies.

THE Danish Meteorological Institute has published its report for 1917 on the state of the ice in the Arctic seas (Isforholdene i de Arktishe Have). War conditions have made it impossible to obtain as full reports as usual except from the coasts of Greenland, Iceland, Spitsbergen, and the Barents Sea. In Spitsbergen and the Barents Sea the ice conditions were again abnormal and most unfavourable. The winter ice in Spitsbergen fjords broke up a month later than usual, and the autumn ice formed several weeks ahead of the average date. There was pack-ice off the west coast of Spitsbergen throughout the summer months. The coast was most approachable during the first half of August and the second half of September. Throughout the summer it seems, as usual, to have been easier to enter King's Bay than fjords further south, but until late in July the pack on the west coast of Spitsbergen more or less met the pack of the Greenland Sea, and on this account it was not easy to reach the open water north of Prince Charles Foreland. Storfjord seems to have been clear of ice in September, and possibly in August. Reports from the Kara Sea are scanty, but the ice conditions there seem to have been bad. No vessel attempted to make the passage in 1917.

SOME explorations in the previously little-known Tibetsi highlands of the Sahara by Col. Jean Tilho are summarised in an article in *La Géographie*, vol. xxxi., Nos. 6–8. The explorations were part of a long series of journeys between Lake Chad and the Anglo-Egyptian Sudan undertaken in the years 1912–17. Col. Tilho has established that the Tibetsi highlands are not a single range lying north-west and south-east, but consist of four, or perhaps five, ranges radiating between west-north-west and north-east from the Koussi massif. In this massif is the extinct volcano of Emi-Koussi, which rises to a height of 11,155 ft. above sea-level, and marks the summit of the Tibetsi highlands. Emi-Koussi has an enormous crater, eight miles long and about five miles broad, within which are several secondary craters, of which Era Kohor has a diameter of about two miles. In the bottom of this crater is a deposit of sodium carbonate covering about 100 acres and at least 4 ft. in depth. There is clear evidence of the former existence of a lake, but there is now no water. Among other interesting results, Col. Tilho claims to have established definitely that there was never any connection between Lake Chad and the Nile. Material has been obtained in most of the region traversed for a new map, which has been drawn on a scale of 1 to 1,000,000. No map accompanies the article.

THE report on rainfall registration in 1916 in Mysore has just reached us. It includes maps showing the actual rainfall for the year 1916, and the average annual rainfall for the period 1870–1915. On June 25, 1916, more than 16 in. of rain fell during twenty-four hours at Nagar in the Shimoga district; the total rainfall at that place during June was 38 in., nearly 50 per cent. above the normal, although the total fall for 1916 was practically normal at 104 in. The rains during October and November, 1916, were above the normal on account of an exceptional number of cyclonic storms, which originated in the Bay of Bengal. The rains were on the whole but half of the normal during the cool-weather period, January and February, and also during March, the beginning of the hot-weather period. The deficiency was more than made up during the rest of the year, especially in the north-east monsoon period from October to the end of the year. The tables occupy fifty-eight pages, and give the details for the 224 stations under various heads; a notable table is that which gives the distribution in the river valleys.

WEATHER-CONTROLS over the fighting in Mesopotamia, in Palestine, and near the Suez Canal is the subject of an article by Prof. Robert DeC. Ward, of Harvard University, in the *Scientific Monthly* (April). Mesopotamia is characterised as "a country of aridity, of intense summer-heat, of deserts and steppes, of relatively mild winter, and of cold-season rains." The mean temperature at Bagdad for January is given as 48·7° F., and for August 92·5°; the mean maximum is 119·5°, and the mean minimum 21·9°, which are the mean extremes in the year. Winter frosts occur and snow falls locally. The total mean annual rainfall is only about 8 in. or 9 in., and in some years only about half as much. The rain falls between October and May, and the remaining months are practically rainless. February or March is the rainiest month, and the floods come in March and April. The climate of Palestine has been discussed by Exner and Hann, and the article quotes various data. The coast stations have a mean midwinter temperature of between 50° and 55° F., and mean midsummer temperature of 75° to 80°. The hill stations, at elevations of about 1500 ft. to 3000 ft., have mean midwinter temperatures from 45° to 50°, and midsummer means from 70° to a little under 80°. In the Jordan valley the temperatures range from 55° in midwinter to 85° or 90° in midsummer. Jerusalem averages 3·6 days a year with temperature below freezing, and the highest summer temperatures reach 100° to 105°. The annual rainfall at the coast stations ranges from 15 in. to 35 in., and at Jerusalem it is 26 in., no rain falling in June, July, and August. The rainy season extends from the middle of October to early in May. In the district of the Suez Canal the complete absence of rain for months together and the exceptionally small total annual fall in places immensely augments the difficulty of transport. The writer of the article says that winter is the best season for a campaign, both on account of the better water supply and of the lower temperature.

A PRELIMINARY report on the mineral production of Canada during the year 1917 has been issued by the Canadian Department of Mines. Although the total value of this production shows an increase over that for the previous year to the extent of 8·9 per cent., this is due almost entirely to increased values of the products, the quantities showing actual decreases in many cases. Thus the coal output, a little above 14 million tons, shows a decrease of 3·2 per cent.; the production of copper shows a decrease of 7·08 per cent., of lead of 22·71 per cent., of silver of 13 per cent., and of gold of 19·68 per cent. On the other hand, the production of zinc increased by 33·5 per cent., and that of cobalt by 29·62 per cent. There were trifling increases in the production of nickel and of pig-iron, though in the latter case this was due entirely to the production of iron in the electric furnace; furthermore, the pig-iron produced from Canadian ores showed a heavy decline, more imported ore having been smelted in 1917 than in 1916; a large proportion of the latter consists of Wabana ore from Newfoundland. Upon the whole, it may fairly be said that the mineral industry of Canada is holding its own reasonably well under the severe stress of war conditions.

IN the *Elektrotechnische Rundschau* for September 26, 1917, a writer directs special attention to the process of steel hardening by air-blast, owing to shortage of oils in Germany. The hot tool is placed in an attachment capable of rotating freely. It is then exposed to the cold blast forced through a number of tubes in such a way as to rotate the tool. Drills, turning-tools, and other simple pieces may be cooled in the blast from a fan.

ACCELERATION in the deposition of metallic deposits may be obtained by suitable electrolytes, stirring the bath, and applying high temperatures. In this way it has been possible (according to *Elektrotechnik und Maschinenbau*, October 14, 1917) to produce cobalt deposits in three to five minutes with a current density of 29 amps. per dm.^{2} A nickel deposit that previously required $1\frac{1}{2}$ hours can now be made in five minutes by using a solution of 220 grams nickel-sulphate, 21 grams nickel-chloride, and 21 grams boracic acid to one litre of water at 70° C., and using a current density of from 25 to 39 amps. per sq. dm. The action of high temperatures is said to bring about an increase of concentration of the ions. The method is not of universal application, as all solutions do not allow high temperatures to be used.

K. H. GÜLDNER, in the *Zeitschrift des Vereines deutscher Ingenieure* for August 11 and 18, 1917, describes some investigations which he has carried out to determine the lateral deviation of projectiles caused by the spin imparted to them by the rifling of a trench-mortar. The trench-mortar provides a suitable means of carrying out such tests, as the motion of the projectile may be followed by the eye. Rifling with a right-handed twist may cause constant lateral deviation both to the right and left. Right or left deviation is the result of right or left precession, and is visible to the naked eye. Left precession with rifling having a right-handed twist can occur only after the maximum height of the trajectory has been passed if the centre of action of the air-resistance lies behind the centre of gravity of the shell. The precession on the ascending part of the trajectory is always greater than in the descending part.

THE making of accurate screw gauges presents considerable difficulties, as is well known to those who undertook to manufacture these appliances for the Ministry of Munitions. A lathe having many novel features has been designed and made at the request of the Ministry by Messrs. Bryant, Symons, and Co., 320 St. John Street, London, E.C.1, and is described in *Engineering* for May 24. Both centres are dead centres, thus ensuring that work shall be round and not slightly elliptical. The effective pitch of the lead screw can be varied at will, so that it can produce a thread of slightly greater or smaller pitch than the standard; in this way shrinkage during hardening can be provided for in advance. The lead screws of all these lathes are tested separately, and a correction bar is fitted to compensate for local errors in each lead screw. Each tool, when sold, is accompanied by a certificate from the National Physical Laboratory as to its performance, and the certificate gives the errors found in a screw 8 in. long actually cut in the machine. The design of the machine, so far as can be determined from the drawings and photographs given in the article, is excellent, and the lathe should form a valuable addition to the equipment of gauge shops.

The May issue of the Transactions of the Optical Society is devoted almost entirely to papers on the methods of design of telescopic objectives. Mr. P. F. Everitt sets out clearly in order of importance the six conditions which it is desirable that an objective, so far as is practicable, should fulfil. He then shows how, by the help of tables such as those of Smith and Cheshire, the approximate radii of the surfaces of the objective are found, and corrected by tracing the paths of an axial and an edge ray through the system. Mr. T. Smith gives an account of the methods in use at the National Physical Laboratory which have furnished the tables just mentioned, and Mr. S. D. Chalmers gives an alternative method of making the calculation. In the discussion of the three papers Prof. Cheshire emphasised the importance of accurate computation of the properties of an objective before the manufacturer put tool to glass. We cannot in modern times wait for a sample to be made and tested before producing instruments in quantity. Mr. Conrady and Mr. Hasselkus contended that an objective should be designed to compensate the errors of the common eye-pieces, while Mr. Everitt declined to saddle the objective with this task.

Mr. C. Turnbull read a paper to the Institution of Electrical Engineers on May 9 in which he urged the necessity of having a "national proving house" for testing British engineering apparatus and materials. Although most of the speakers agreed with Mr. Turnbull, no one advanced any real proof that there was any urgent necessity for a commercial laboratory of this kind. We are not aware that there is any appreciable quantity of inferior apparatus or shoddy electrical materials in the market. The president, Mr. C. H. Wordingham, in opening the discussion, gave a summary of a report of the committee of the council which had been considering the subject. He began by saying that the proving house would not enter into competition with existing institutions, but it will be difficult to avoid doing so. It will be remembered that when the National Physical Laboratory was started this consideration caused considerable friction. As a proving house will have to be largely, if not altogether, self-supporting, little research work can be undertaken. Sir Richard Glazebrook welcomed the suggestion that the proving house should work in conjunction with the National Physical Laboratory. The experience of the working of the National Board of Fire Underwriters of the U.S.A., which has what is practically an electrical proving house, shows, however, that the main problems it is forced to consider are political, commercial, and international rather than scientific. Hence it may be advisable to leave the problems of a British national proving house to the engineers' and manufacturers' associations, as they are free to deal with such questions. Unless a much stronger case can be made out for it, the whole proposal will probably fall through.

In the Kjeldahl method for the estimation of nitrogen in organic compounds the substance is usually—in fact, almost invariably—digested with the sulphuric acid until a clear, transparent liquid is obtained. With some substances, *e.g.* indiarubber, a very prolonged period of digestion is thereby rendered necessary. Mr. Matthew Howie finds, however (Journal of the Society of Chemical Industry, March 30), that the whole of the nitrogen present in rubber is converted into ammonia in less time than is required to effect the complete dissolution of the substance. Using samples of plantation sheet and of Manihot rubber, it was found that 80 per cent. to 94 per cent. of the nitrogen was converted into ammonia after one hour's digestion, whilst three to four hours' digestion gave as high a nitrogen value as the six hours necessary for complete clarification of the solution. It is possible that in the case of other highly resistant nitrogenous substances the Kjeldahl estimation might be similarly shortened.

OUR ASTRONOMICAL COLUMN.

May Meteors.—Between May 17 and 24 meteors have occasionally been abundant and given evidence of several well-defined showers. Whether or not this period is worthy of special note cannot be absolutely affirmed, though the evidence strongly suggests that it needs further investigation. This year some fine meteors were observed at Bristol on the mornings of May 18 and 19, and proved that several of the various systems which mark this epoch returned with tolerable strength.

In 1866, May 18, several of the assistants of the Royal Observatory, Greenwich, remarked a striking prevalence of bright meteors, and Mr. Denning found on projecting the roughly observed paths that the radiant was placed at $247^\circ+32^\circ$ near ζ Herculis. This shower was observed at Bristol in 1903, 1911, and a few other years, and from a general investigation of all the meteor tracks recorded at the latter station since 1875 during the period May 17–24 the following radiants seem well defined:—

° °	° °	° °	° °
194 + 57	245 + 62	280 − 13	312 + 61
223 + 41	248 + 29	280 + 31	316 + 31
227 − 6	254 − 21	290 + 60	331 + 50
230 + 33	263 + 37	291 + 52	332 + 71
231 + 27	270 + 47	294 ± 0	334 + 58
241 + 48	273 + 22	311 + 80	354 + 40

Many periods of the year appear to be more noteworthy for the large number of streams visible than for the special richness of one or two.

Distance of the Pleiades.—Prof. W. H. Pickering has made a further application of the statistical method to the determination of the distance of the Pleiades (Harvard Circular, No. 206). Absolute magnitudes were calculated by Russell's formula $M=0\cdot6+2\cdot1(T-2)$, where M is the absolute magnitude and T the type of spectrum, counting B as 1, A as 2, F as 3, G as 4, and K as 5. The eighty-two stars considered range in type from B5 to A9, and, omitting the six brightest stars as being possible "super-giants," the average difference between apparent and absolute magnitudes is 6·46. This corresponds with a distance of 201 parsecs, or 656 light-years, the parallax being $0\cdot0050'' \pm 0\cdot0008''$. It thus appears that the Pleiades are about five times as remote as the Hyades, while the distance between the two farthest apart of the bright stars (63′) is 12 light-years. The brightness of Alcyone is estimated to be 2100 times that of the sun, while the other five bright stars average about 800 times as bright as the sun.

By the same method Prof. Pickering finds 301 light-years, or a parallax of $0\cdot0109'' \pm 0\cdot0026''$, for the Coma Berenices cluster.

The Spectroscopic Binary 42 Capricorni.—The variable radial velocity of this star was shown in two photographs taken by Dr. Lunt at the Cape Observatory in October of last year, and data for the computation of a provisional orbit were provided by fifteen plates taken later (*Astrophysical Journal*, vol. xlvii., p. 134). The magnitude of the star is 5·28, and the spectrum of type K. The semi-amplitude of the velocity curve is 22·75 km./sec., and the system is approaching with a velocity of 3·0 km./sec. relatively to the sun, or receding at 7·3 km./sec. when the component of the solar motion is eliminated. The star is of special interest, inasmuch as the period is only 13·25 days, whereas Campbell found no spectroscopic binaries of the later types G, K, and M having periods less than twenty days.

THE TOTAL SOLAR ECLIPSE OF JUNE 8, 1918.

THE "Eclipse Number" of *Popular Astronomy* (vol. xxvi., No. 5, May) gives special prominence to a number of articles on the approaching total eclipse of the sun visible in the United States. Prof. H. C. Wilson gives a general account of eclipse phenomena and of the circumstances of the eclipse of June 8, to which is appended a series of letters indicating the plans of leading astronomers for observing the eclipse. The shadow first strikes the earth in the Pacific south of Japan, then passes north-westward, and reaches its highest latitude about 500 miles south of the Alaskan coast in long. 152° W.; on its landward course it passes from the western coast of Washington by way of Denver to Florida, the duration of totality on the central line gradually diminishing from 121 to 50 sec. Quite a large number of American astronomers are too fully occupied with war-work to undertake observations, but several well-equipped parties will occupy stations along the track. Ample provision appears to have been made for direct photographs of the corona on large and small scales, as well as for spectroscopic observations, and some of the observers will make special efforts to obtain photographs suitable for testing the deflection of rays of light from stars near the sun which is predicted by Einstein's theory of relativity. Prof. Hale will be in Wyoming with a party from the Mt. Wilson Observatory, and will attempt to determine the rotation of the corona from displacements of the green coronal line, besides obtaining photographs for studies of the chromospheric spectrum at different levels. Prof. Campbell's programme is somewhat restricted by the delay in the return of the instruments employed by him in Russia in 1914, but some instruments are available for photographs of the corona and of its spectrum.

The observations proposed by Prof. Abbot include measures of the brightness of the sky and of the outgoing radiation before, during, and after the eclipse. Prof. Stebbins will endeavour to secure photometric measures of the corona by means of potassium and rubidium photo-electric cells. A large party from the U.S. Naval Observatory will be located at Baker, Oregon, and, in addition to many other observations, will attempt to extend the spectroscopic observations into the extreme red by the use of plates stained with dicyanin. Profs. Frost and Barnard have also prepared an extensive programme of photographs of the corona and its spectrum at Green River, Wyoming. In a separate article Prof. Frost directs attention to the valuable observations of the chromospheric spectrum which are possible at places within 200 miles of the eclipse track, as indicated by Newall and Fowler in 1912.

On account of the war, it is not expected that there will be any expeditions from foreign countries to observe this eclipse.

DIURNAL VARIATION OF ATMOSPHERIC PRESSURE.

THE effect of geographical latitude on the semi-diurnal wave of atmospheric pressure is fairly regular and well marked, but the variation of the diurnal wave has attracted less attention since Angot in 1887, and also Hann, showed conclusively its dependence on secondary local conditions. Three Japanese investigators from the Geophysical Seminary of the Physical Institute, Tokyo, contribute an account[1] of a preliminary attempt to trace more definitely the mechanism of these local influences, one of the most obvious of which, under the name of "continentality," has recently been attracting the attention of Mr. C. E. P. Brooks in this country in connection with climate, and with a purely geographical theory of the Ice age.

The elementary definition of continentality as the percentage of land in a circle of definite size (say 10° radius) surrounding the station is clearly insufficient, so much depending upon the orientation and shape of the coast line or lines that the form of the function is bound to be complicated. The Japanese authors soon come to the conclusion that it is not linear, and are constrained to make a series of simplifying assumptions in order to reach a workable hypothesis. The assumptions are no more probable than those of the early days of the theory of tides, with which the present problem has obvious analogies.

With these limitations the authors appear to account for such features as the variation with longitude, the inversion of phase near the poles, and the minimum amplitude near the coast, but a general solution of the problem has evidently not yet been reached. They indicate the lines on which they propose to continue the investigation, and conclude with a representative set of daily variation curves for ten British observatories, showing considerable dissimilarity, those of Oxford and Aberdeen, for instance, being almost the converse of each other. A systematic series of stations within the Empire, chosen with special reference to the elucidation of this problem, may well form part of the programme of co-ordinated British Empire meteorology so strongly advocated by Major Lyons in his presidential address to the Royal Meteorological Society.

The barometric variations dealt with in the above paper, as generally studied, are naturally to be regarded as vertical oscillations of the free atmosphere, though there is a possible difficulty in the differentiation between statical and dynamical pressure, when an ascending or descending current is in question. But there is also a very decided horizontal oscillation or motion of the free atmosphere, and this has begun to attract attention since the use of pilot balloons has provided more information about the direction of the wind at different heights than can be inferred from the motion of clouds. A paper from Batavia[2] has appeared in the Proceedings of the Royal Academy of Amsterdam dealing with the semi-diurnal variation of this motion.

There is a good deal of uncertainty about the investigation, even in a favourable place like Batavia, where atmospheric conditions are as a rule very quiet and steady. Observations were made not only at Batavia, but also at a neighbouring mountain station of 3000 metres elevation, as well as from a small coral island, to eliminate the land-effect. Single observations are

[1] "On Diurnal Variation of Barometric Pressure." By T. Terada, M. Kiuti, and J. Tukamoto. Journal of the College of Science, Imperial University of Tokyo, vol. xli., art. 1 (November 20, 1917).

[2] "The Semi-diurnal Horizontal Oscillation of the Free Atmosphere up to 10 km. above Sea-level Deduced from Pilot-Balloon Observations at Batavia." By W. van Bemmelen and J. Boerema. Proceedings Royal Acad. Amsterdam, vol. xx., pp. 119–35+plate.

included, especially at times of the day when convection currents are not in evidence in the lower atmosphere, otherwise double observations by day and by night were obtained with different base-lines of approximately half a mile, one mile, and one and a half miles in length. Some hundreds of ascents were observed, of which a fair proportion reached a height between 9 and 11 km., only 30 per cent. failing to reach the 4-km. level.

The data are admittedly insufficient to determine a diurnal oscillation, but Dr. van Bemmelen is fairly satisfied with the result for the semi-diurnal one. The east and north components are treated separately, and it is found that the former has a greater amplitude than the latter, and also a better determined phase. Gold's theoretical results for the lower layers are confirmed (*Phil. Mag.*, vol. xix.). The phase of the east component diminishes up to 4 km., and probably increases above that height, showing a fairly close analogy with the vertical oscillations. W. W. B.

RECONSTRUCTION IN FRANCE.

THE issue of the *Revue Scientifique* for April 13 contains evidence that our French neighbours are discussing the problems of reconstruction on much the same lines as we are. In an article on agriculture in 1917, M. Albin Haller, president of the Académie d'Agriculture, deals with the present effects of the war on agriculture and the outlook after the war, particularly in regard to the supply of artificial manures. He points out that war conditions have led to a diversion of the supply of nitrogenous manures to the manufacture of explosives, and that after the war it will be necessary to make up for the lost fertility of the soil by State efforts in the direction of stimulating the home supply of nitrogenous fertilisers from such sources as the by-products of gas- and coke-making, or even from special plants devoted to nitrogen fixation. In regard to the latter, he rightly points out that the feasibility may depend upon the harnessing of the waterfalls of the country—a point that we might well take to heart when we consider the immense possibilities of the Highlands of Scotland in this direction. M. Haller also throws out suggestions in regard to the future supply of phosphatic fertilisers, again touching a problem which is engaging attention here. The fact that the State now controls the production of sulphuric acid, and that, owing to its command over Australian zinc "concentrates," it may be able to market the acid as a waste product, inevitably suggests State enterprise in the future production of fertilisers as an adjunct to its food-production campaign.

An article in the same issue by M. Brucker, Principal of the Lycée de Cherbourg, entitled "L'Education de l'esprit scientifique," may be paralleled by the Report of the Committee appointed by the Prime Minister to inquire into the position of natural science in the educational system of Great Britain. It is perhaps characteristic of the two nations that, whereas the former is largely devoted to a discussion of the abstract and logical principles of scientific education—whether, for example, the methods should be synthetic or analytic—the latter concerns itself largely with the concrete problems of curricula, supply and training of teachers, etc. One rarely reads the writings of an educated Frenchman without having some cause to envy his possession of a language which is such an elegant vehicle for the picturesque, and, at the same time, precise expression of ideas. Such an instance can be cited in M. Brucker's characterisation of scientific definition as "une lutte contre le psittacisme," or, when quoting another writer, he speaks of "battant la paille des mots pour en faire tomber le grain des choses." May we commend the latter operation to our politicians? B.

RADIATION AND THE ELECTRON.[1]

II.

IN spite of the credentials which have just been presented for Einstein's equation, we are confronted with the extraordinary situation that the semi-corpuscular theory out of which Einstein got his equation seems to be wholly untenable, and has, in fact, been pretty generally abandoned, though Sir J. J. Thomson[2] and a few others[3] seem still to adhere to some form of æther-string theory—that is, to some form of theory in which the energy remains localised in space instead of spreading over the entire wave front.

Two very potent objections, however, may be urged against all forms of æther-string theory, of which Einstein's is a particular modification. The first is that no one has ever yet been able to show that such a theory can predict any one of the facts of interference. The second is that there is direct positive evidence against the view that the æther possesses a fibrous structure. For if a static electrical field has a fibrous structure, as postulated by any form of æther-string theory, "each unit of positive electricity being the origin, and each unit of negative electricity the termination, of a Faraday tube,"[4] then the force acting on one single electron between the plates of an air condenser cannot possibly vary *continuously* with the potential difference between the plates. Now in the oil-drop experiments (*Phys. Rev.*, vol. ii. [1913], p. 109) we actually study the behaviour in such an electric field of one single, isolated electron, and we find, over the widest limits, exact proportionality between the field strength and the force acting on the electron as measured by the velocity with which the oil drop to which it is attached is dragged through the air.

When we maintain the field constant and vary the charge on the drop, the granular structure of electricity is proved by the discontinuous changes in the velocity, but when we maintain the charge constant and vary the field the lack of discontinuous change in the velocity disproves the contention of a fibrous structure in the field, unless the assumption be made that there are an enormous number of æther strings ending in one electron. Such an assumption takes all the virtue out of an æther-string theory.

Despite, then, the apparently complete success of the Einstein equation, the physical theory of which it was designed to be the symbolic expression is found so untenable that Einstein himself, I believe, no longer holds to it, and we are in the position of having built a very perfect structure and then knocked out entirely the underpinning without causing the building to fall. It stands complete and apparently well tested, but without any visible means of support. These supports must obviously exist, and the most fascinating problem of modern physics is to find them. Experiment has outrun theory, or, better, guided by erroneous theory, it has discovered relationships which seem to be of the greatest interest and importance, but the reasons for them are as yet not at all understood.

It is possible, however, to go a certain distance towards a solution and to indicate some conditions which must be satisfied by the solution when it is found. For the energy $h\nu$ with which the electron is found by experiment to escape from the atom must have come either from the energy stored up inside the atom or else from the light. There is no third possibility.

[1] Address to the Section of Physics and Chemistry of the Franklin Institute, Philadelphia, on January 4, 1917, by Prof. R. A. Millikan, professor of physics in the University of Chicago. The substance of this lecture has since been incorporated into a book recently issued by the University of Chicago Press, entitled "The Electron." Continued from p. 237.

[2] Proc. Phys. Soc. of London, vol. xxvii. (December 15, 1914), p. 105.

[3] "Modern Electrical Theory" (Cambridge University Press, 1913), p. 248.

[4] J. J. Thomson, "Electricity and Matter," p. 9.

Now the fact that the energy of emission is the same, whether the body from which it is emitted is held within an inch of the source, where the light is very intense, or a mile away, where it is very weak, would seem to indicate that the light simply pulls a trigger in the atom, which itself furnishes all the energy with which the electron escapes, as was originally suggested by Lenard in 1902 (*Ann. d. Phys.* [4], vol. viii. [1902], p. 149), or else, if the light furnishes the energy, that light itself must consist of bundles of energy which keep together as they travel through space, as suggested in the Thomson-Einstein theory.

Yet the fact that the energy of emission is directly proportional to the frequency ν of the incident light spoils Lenard's form of trigger theory, since, if the atom furnishes the energy, it ought to make no difference what kind of wave-length pulls the trigger, while it ought to make a difference what kind of gun—that is, what kind of atom—is shot off. But both these expectations are the exact opposite of the observed facts. *The energy of the escaping corpuscle must come then, in some way or other, from the incident light.*

When, however, we attempt to compute on the basis of a spreading-wave theory how much energy a corpuscle can receive from a given source of light, we find it difficult to find anything more than a very minute fraction of the amount which the corpuscle actually acquires.

Thus, the total luminous energy falling per second from a standard candle on a square centimetre at a distance of 3 m. is 1 erg.[5] Hence the amount falling per second on a body of the size of an atom, *i.e.* of cross-section 10^{-15} cm., is 10^{-15} ergs, but the energy $h\nu$ with which a corpuscle is ejected by light of wave-length 500 $\mu\mu$ (millionths millimetre) is 4×10^{-12} ergs, or 4000 times as much. Since not a third of the incident energy is in wave-lengths shorter than 500 $\mu\mu$, a surface of sodium or lithium which is sensitive up to 500 $\mu\mu$ should require, even if all this energy were in one wave-length—which it is not—at least 12,000 seconds, or four hours, of illumination by a candle 3 m. away before any of its atoms could have received, all told, enough energy to discharge a corpuscle. Yet the corpuscle is observed to shoot out the instant the light is turned on. It is true that Lord Rayleigh has recently shown (*Phil. Mag.*, vol. xxxii. [1916], p. 188) that an atom may conceivably absorb wave-energy from a region of the order of magnitude of the square of a wave-length of the incident light rather than of the order of its own cross-section. This in no way weakens, however, the cogency of the type of argument just presented, for it is only necessary to apply the same sort of analysis to the case of γ rays, the wave-length of which is of the order of magnitude of an atomic diameter (10^{-8} cm.), and the difficulty is found still more pronounced. Thus Rutherford[6] estimates that the total γ-ray energy radiated per second by one gram of radium cannot possibly be more than $4{\cdot}7 \times 10^4$ ergs. Hence at a distance of 100 m., where the γ rays from a gram of radium would be easily detectable, the total γ-ray energy falling per second on a square millimetre of surface, the area of which is ten-thousand billion times greater than that either of an atom or of a disc the radius of which is a wave-length, would be $4{\cdot}7 \times 10^4 \div 4\pi \times 10^{10} = 4 \times 10^{-7}$ ergs. This is very close to the energy with which β rays are actually observed to be ejected by these γ rays, the velocity of ejection being about nine-tenths that of light. Although, then, it should take ten thousand billion seconds for the atom to gather in this much energy from the γ rays, on the basis of classical theory the β ray is observed to be ejected with this energy as soon as the radium is put in place. This shows that if we are going to abandon the Thomson-Einstein hypothesis of localised energy, which is, of course, competent to satisfy these energy relations, there is no alternative but to assume that at some previous time the corpuscle had absorbed and stored up from light of this or other wave-length enough energy so that it needed only a minute addition at the time of the experiment to be able to be ejected from the atom with the energy $h\nu$.

Now the corpuscle which is thus ejected by the light cannot possibly be one of the free corpuscles of the metal, for such a corpuscle, when set in motion within a metal, constitutes an electric current, and we know that such a current at once dissipates its energy into heat. In other words, a *free* corpuscle can have no mechanism for storing up energy and then *jerking* itself up "by its boot straps" until it has the huge speed of emission observed.

The ejected corpuscle must then have come *from the inside of the atom*, in which case it is necessary to assume, if the Thomson-Einstein theory is rejected, that within the atom there exists some mechanism which will permit a corpuscle continually to absorb and load itself up with energy of a given frequency until a value at least as large as $h\nu$ is reached. What sort of a mechanism this is we have at present no idea. Further, if the absorption is due to resonance—and we have as yet no other way in which to conceive it—it is difficult to see how there can be, in the atoms of a solid body, corpuscles having all kinds of natural frequencies so that some are always found to absorb and ultimately to be rejected by impressed light of any particular frequency. But apart from these difficulties, the thing itself is impossible if these absorbing corpuscles, when not exposed to radiation, are emitting any energy at all; for if they did so, they would in time lose all their store, and we should be able, by keeping bodies in the dark, to put them into a condition in which they should show no emission of corpuscles whatever until after hours, or years, of illumination with a given wave-length. Since this is contrary to experiment, we are forced, even when we discard the Thomson-Einstein theory of localised energy, to postulate electronic absorbers which, during the process of absorbing, do not radiate at all until the absorbed energy has reached a certain critical value when explosive emission occurs.

However, then, we may interpret the phenomenon of the emission of corpuscles under the influence of æther waves, whether upon the basis of the Thomson-Einstein assumption of bundles of localised energy travelling through the æther, or upon the basis of a peculiar property of the inside of an atom which enables it to absorb continuously incident energy and emit only explosively, *the observed characteristics of the effect seem to furnish proof that the emission of energy by an atom is a discontinuous or explosive process.* This was the fundamental assumption of Planck's so-called quantum theory of radiation. The Thomson-Einstein theory makes both the absorption and the emission sudden or explosive, while the loading theory, first suggested by Planck, though from another viewpoint, makes the absorption continuous and only the emission explosive.

The h determined above with not more than one-half of 1 per cent. of uncertainty is the explosive constant, *i.e.* it is the unchanging ratio between the energy of emission and the frequency of the incident light. It is a constant the existence of which was first discovered by Planck by an analysis of the facts of black-body radiation, though the physical assumptions underlying Planck's analysis do not seem to be tenable any longer. For the American physicists Duane and Hunt (*Phys. Rev.*, vol. vi. [1915], p. 166) and Hull (*ibid.*,

[5] Drude, "Lehrbuch der Optik" (1906), p. 472.
[6] "Radioactive Substances and their Radiations," p. 288.

vol. vii. [1916], p 157) have recently shown that the same quantity h appears in connection with the impact of corpuscles against any kind of target, the observation here being that the highest frequency in the general or white-light X-radiation emitted when corpuscles impinge upon a target is found by dividing the kinetic energy of the impinging corpuscle by h. Since

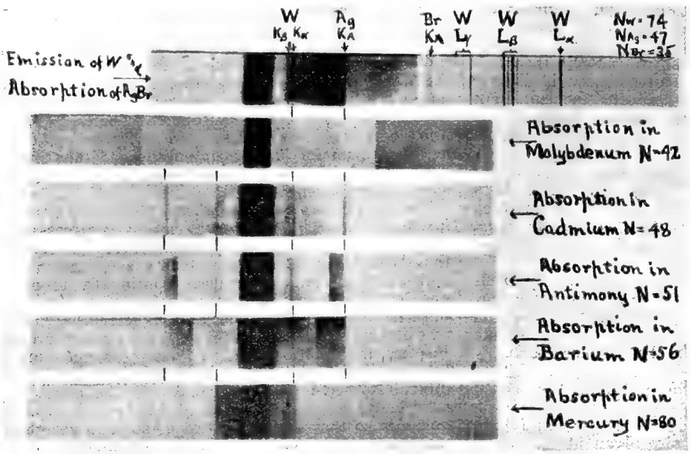


FIG. 6.—Absorption of certain substances in region of K-radiations.

black-body radiation is presumably due to the impact of the *free* corpuscles within a metal upon the atoms, it is probable that the appearance of h in black-body radiation and in general X-radiation is due to the same cause, so that, contrary to Planck's assumption, there need not be, in either of these cases, any coincidence between natural and impressed periods at all. The $h\nu$ which here appears is not a characteristic of the atom, but merely a property of the æther pulse which is generated by the stopping of a moving electron. Why this æther pulse should be resolvable into a continuous or white-light spectrum, which, however, has the peculiar property of being chopped off sharply at a particular limiting frequency given by $h\nu = \mathrm{PD} \times e$ is thus far a complete mystery. All that we can say is that experiment seems to demand a sufficient modification of the æther-pulse theory of white-light and of general X-radiation to take this experimental fact into account.

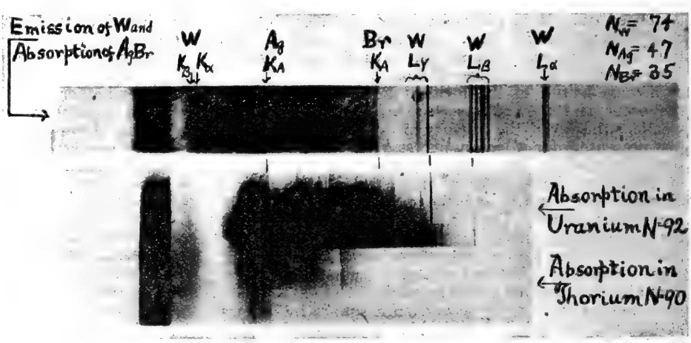


FIG. 7.—Absorption of uranium and thorium in region of L-radiations.

On the other hand, the appearance of h in connection with the absorption and emission of *monochromatic* light (photo-electric effect and Bohr atom) seems to demand some hitherto unknown type of absorbing and emitting mechanism within the atom. This demand is strikingly emphasised by the remarkable absorbing property of matter for X-rays discovered by Barkla (*Phil. Mag.*, vol. xvii. [1909], p. 749) and beautifully exhibited in De Broglie's photographs here shown (Figs. 6 and 7).[7] It will be seen from these photographs that *the atoms of each particular substance transmit the general X-radiation up to a certain critical frequency and then absorb all radiations of higher frequency than this critical value.* The extraordinary significance of this discovery lies in the fact that it indicates that there is a type of absorption which is not due either to resonance or to free electrons. But these are the only types of absorption which are recognised in the structure of modern optics. We have as yet no way of conceiving of this new type of absorption in terms of a mechanical model.

There is one result, however, which seems to be definitely established by all this experimental work. Whether the radiation is produced by the stopping of a free electron as in Duane and Hunt's experiment, and presumably also in black-body experiments, or by the absorption and re-emission of energy by bound electrons, as in photo-electric and spectroscopic work, Planck's h seems to be always tied up in some way with the emission and absorption of energy by the electron. *h may, therefore, be considered as one of the properties of the electron.*

The new facts in the field of radiation which have been discovered through the study of the properties of the electron seem, then, to require in any case a fundamental revision or extension of classical theories of absorption and emission of radiant energy. The Thomson-Einstein theory throws the whole burden of accounting for the new facts upon the unknown nature of the æther and makes radical assumptions about its structure. The loading theory leaves the æther as it

[7] These photographs will be found also in the August, 1917, number of the *Physical Review* (see presidential address of the president of the Physical Society).

was and puts the burden of an explanation upon the unknown conditions and laws which exist inside the atom. I have already given reasons for discrediting the first type of theory. The second type, though as yet very incomplete, seems to me to be the only possible one, and it has already met with some notable successes, as in the case of the Bohr atom. Yet the theory is at present woefully incomplete and hazy. About all that we can say now is that we seem to be driven by newly discovered relations in the field of radiation either to the Thomson-Einstein semi-corpuscular theory, or else to a theory which is equally subversive of the established order of things in physics. For either one of these alternatives brings us to a revolutionary quantum theory of radiation—that is, a theory which calls for an explosive emission of energy in units and has therefore something akin to atomism about it. To be living in a period which faces such a complete reconstruction of our notions as to the way in which æther waves are absorbed and emitted by matter is an inspiring prospect. The atomic and electronic worlds have revealed themselves with beautiful definiteness and wonderful consistency to the eye of the modern physicist, but their relation to the world of æther waves is still to him a profound mystery for which the coming generation has the incomparable opportunity of finding a solution.

GEOLOGICAL STRUCTURE IN RELATION TO MAGNETIC DISTURBANCE.

A LECTURE on the relationship between geological structure and magnetic disturbance, with especial reference to Leicestershire and the concealed coalfield of Nottinghamshire, was delivered before the Geological Society on May 1 by Dr. A. Hubert Cox.

Before the lecture, at the request of the president, Dr. A. Strahan, director of the Geological Survey, briefly outlined the circumstances that had led to an investigation into a possible connection between geological structure and magnetic disturbances. The magnetic surveys conducted by Rücker and Thorpe in 1886 and 1891 had proved the existence of certain lines and centres of disturbance, but those authors observed that "the magnetic indications appear to be quite independent of the disposition of the newer strata," and Dr. Strahan had not been able to detect any obvious connection with the form and structure of the Palæozoic rocks below. In 1914–15 a new magnetic survey was made by Mr. G. W. Walker, who confirmed the existence of certain areas of disturbance. It was suggested that the effects might be due to concealed masses of iron ore, and the matter was referred to the Conjoint Board of Scientific Societies, which appointed an Iron Ores Committee to consider what further steps should be taken. The committee recommended that attention should be concentrated on certain areas of marked magnetic disturbance, and that a more detailed magnetic survey of these areas, accompanied by a petrological survey and an examination of the magnetic properties of the rocks of the neighbourhood, should be made. Dr. Strahan had been approached with a view to the petrological work being undertaken by the Geological Survey, and it had been arranged by the Board of Education, with the consent of H.M. Treasury, that a geologist should be temporarily appointed as a member of the staff for the purposes of the investigation. Dr. Cox had received the appointment, and his lecture would show that results of great significance had been obtained by him. The new magnetic observations had been made by Mr. Walker, and the examination of the specimens collected, in regard to their magnetic susceptibility, had been conducted by Prof. Ernest Wilson.

Dr. Cox then described the selected areas, which lay on Lias and Keuper Marl between Melton Mowbray and Nottingham, and in the neighbourhood of Irthlingborough, where the Northampton Sands are being worked as iron ores. The Middle Lias iron ores, consisting essentially of limonite, which crop out near Melton Mowbray, have been proved incapable, by reason of their low magnetic susceptibility, of causing disturbances of the magnitudes observed, while the distribution of the disturbances showed no correspondence with the outcrop of the iron ores. Nor was any other formation among the Secondary rocks found capable of exerting any appreciable influence. It appeared, therefore, that the origin of the magnetic disturbances must be deep-seated.

Investigation showed that the disturbances were arranged along the lines of a system of faults ranging in direction from north-west to nearly west. The faults near Melton Mowbray have not been proved in the Palæozoic rocks, and, so far as their effects on the Secondary rocks are concerned, they would appear to be only minor dislocations. But farther north, near Nottingham, faults which take a parallel course, and probably belong to the same system of faulting as those near Melton Mowbray, are known from evidence obtained in underground workings to have a much greater throw in the Coal Measures than in the Permian and Triassic rocks at the surface. It appears, therefore, that movement took place along the same lines at more than one period, the earlier and more powerful movement being of post-Carboniferous but pre-Permian age, the later movement being post-Triassic. Accordingly, it is probable that the small dislocations in the Mesozoic rocks indicate the presence of important faults in the underlying Palæozoic.

The faults can give rise to magnetic disturbances only if they are associated with rocks of high magnetic susceptibility. It is known from deep borings that the concealed coalfield of Nottinghamshire extends into Leicestershire, but how far is not known. Deep borings have proved that intrusions of dolerite occur in the Coal Measures at several localities in the south-eastern portion of the concealed coalfield, and always, so far as observed, in the immediate vicinity of faults. It has been established that dolerites may exert a considerable magnetic effect; and the susceptibility of those that occur in the Coal Measures is above the general average. Further, no other rocks that are known to occur, or are likely to occur under the area, have susceptibilities so high as the dolerites found in the Coal Measures. These facts suggest the possibility of the occurrence of dolerites intrusive into Coal Measures beneath the Mesozoic rocks of the Melton Mowbray district.

The distribution of the dolerites actually proved, and of those the presence of which is suspected by reason of the magnetic disturbances, appears to be controlled by the faulting. Moreover, whereas the character of the magnetic disturbances is such that it would not be explained by a sill or laccolite faulted down to the north, in the manner demanded by the observed throw of the principal fault, it would be explained by an intrusion that had arisen along the fault-plane. The faulting itself is connected with a change of strike in the concealed Coal Measures, and the incoming of doleritic intrusions in the concealed coalfield, in contrast with their absence from the exposed coalfield, appears to depend upon the changed tectonic features. The change of strike is apparent, but to a less degree, in the Mesozoic rocks, which, in the neighbourhood of Melton Mowbray, have suffered a local twist due to the development of an east-and-west anticlinal structure.

In view of the evidence that later movements have, in this district, followed the lines of earlier and more powerful movements, it appears possible, and even probable, that this post-Jurassic (probably post-Cretaceous) anticline is situated along the line of a more pronounced post-Carboniferous but pre-Permian anticline. In this connection the isolated position of Charnwood Forest has a considerable significance. The forest is situated on the prolongation of the east-and-west line of uplift, and just at the point where this uplift crosses the line of the more powerful north-westerly and south-easterly (Charnian) uplift. Where the two lines of uplift cross, the elevation attains its maximum, and the oldest rocks appear.

The main line of faulting and of magnetic disturbance is parallel with and on the northern side of the east-and-west anticline, and the faulting is of such a nature that it serves to relieve the folding while accentuating the anticlinal structure. It is possible that this belt of magnetic and geological disturbance marks the southern limit of the concealed coalfield. The results obtained by joint magnetic and geological work have thus served to emphasise the real importance of a structure which, when judged merely from its effects on the surface-rocks, appears to be of only minor importance.

A further series of observations was carried out on the Jurassic iron ores of the Irthlingborough district of Northamptonshire. The ores occur in the form of a nearly horizontal sheet of weakly susceptible ferrous carbonate partly oxidised to hydrated oxides. They give rise to small magnetic disturbances which are quite capable of detection, and these may be of use in determining the boundaries of the sheets in areas not affected by larger disturbances of deep-seated origin.

The results obtained by the joint magnetic and geological work in the two areas show that this method of investigation may be used to extend our knowledge of the underground structure. It appears also that an extension of the method to other parts of the country would yield information of considerable scientific and economic importance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The University has gratefully accepted a gift by Mr. W Denison Roebuck of a unique collection of microscopic slides and a library of books upon the subject of fresh-water Algæ, as the nucleus of a specialist library and collection of Algæ in general. These were the property of Mr. W. B. Turner, who died twelve months ago, and who, since his coming to Leeds in 1877, had been one of the most active scientific workers in the city until laid aside by a serious illness. The value of the gift is enhanced by the fact that many of the books are illustrated by coloured drawings done by Mr. Turner himself, he having been a talented natural history draughtsman. The collections will be known as the "Barwell Turner Memorial," and will be available for the use of students of algological science.

OXFORD.—The annual Halley lecture was delivered on May 28 by Sir Napier Shaw, director of the Meteorological Office. The subject was "The First Chapter in the Story of the Winds." The lecture, which was illustrated by lantern-slides, dealt with Halley as the first framer of a physical explanation of trade winds and monsoons. His views still in part hold good, but the phenomena are more complicated than Halley thought. Contrary to what was once surmised, observation has shown that the horizontal circulation of the air is explicable, the vertical circulation being at present too complex for exact determination, though progress may be hoped for in this direction.

The report for the past year of the visitors of the University Observatory mentions the appointment of Miss Bellamy to assist in the provisional seismological service undertaken by Prof. H. H. Turner on the death of Prof. Milne. Dr. J. K. Fotheringham has received a temporary appointment in connection with his work in the region where astronomy and chronology overlap. Lectures have been delivered by Prof. Turner to military audiences, including some in France, and also others of a popular character. Vol. iii. of the Vatican Zones has been printed and distributed. The work for other of the Vatican Zones has been partly completed, and some Santiago plates have been dealt with, with the aid of a grant from the Royal Society. The counts of stars for the Astrographic Catalogue and the analysis of weather statistics have been continued.

On May 28 the preamble of a statute establishing a definite school of agriculture and forestry was laid before Congregation by the Warden of All Souls'. The statute was supported by Profs. Somerville, Sir W. Schlich, Bourne, and Spenser Wilkinson, and by the Warden of Wadham. It was opposed by Mr. Walker, fellow of Queen's, and on a division the preamble was carried by 53 to 11.

The Romanes lecture will be given by the Right Hon. H. H. Asquith, M.P., on Saturday, June 8, at 3.30 p.m., in the Sheldonian Theatre, on "Some Aspects of the Victorian Age."

THE appointment to the George Henry Lewes studentship for research in physiology at Cambridge University will shortly be made. The studentship is of the annual value of 200*l*., and is open to women. Applications should be made by June 20 to Prof. Langley, Physiology School, Cambridge.

THE Toronto correspondent of the *Times* reports that a movement has been begun at Winnipeg by Sir J. A. Maikins, Lieutenant-Governor of Manitoba, Archbishop Matheson, Primate of All Canada, Sir Augustus Nanton, Prof. W. F. Osborne, of Manitoba University, and others for a conference at which prominent educationists of Canada, Great Britain, and the United States will discuss the best methods to promote ideals of national citizenship and character. The correspondent states that the conference is expected to result in the formation of an unofficial permanent National Board of Education, which will act as a clearing-house for educational ideals and an advisory body for the direction of new methods in education. One particular object of the movement is to improve text-books.

THE meeting of the Physical Society to be held on Friday, June 14, at the Imperial College of Science, will be devoted to a discussion on "The Teaching of Physics in Schools," to be introduced by Sir Oliver Lodge. Contributions to the discussion are expected from Mr. C. E. Ashford, headmaster, R.N. College, Dartmouth; Dr. T. J. Baker, King Edward's High School, Birmingham; Mr. C. L. Bryant, Harrow School; Mr. G. F. Daniell, Educational Department, London County Council; Prof. R. A. Gregory, chairman of the British Association Committee on Science in Secondary Schools; Mr. J. Nicol, Northern Polytechnic, Holloway; Prof. T. P. Nunn, London Day Training College; Mr. F. W. Sanderson, headmaster, Oundle School; Mr. A. T. Simmons, Inspector of Secondary Schools, University of London; Mr. E. Smith, Leyton Secondary School; and Prof. F. Womack, Bedford College. Visitors are invited to attend this meeting of the society.

SOCIETIES AND ACADEMIES.

LONDON.

Optical Society, May 9.—Mr. S. D. Chalmers in the chair.—T. Y. **Baker** and Major L. N. G. **Filon**: Spherical aberration. The authors had considered the subject from the point of view of an optical design for a system of co-axial thin lenses (separated by air) in which the focal lengths and separations of lenses are determined from general consideration of the functions that the instrument has to perform, and from the necessity for correcting for colour. A design carried out in this manner leaves available for the correction of spherical aberration the *forms* of the various lenses. For a thin lens of definite focal length made of a definite variety of glass the difference of curvature of the two faces of the lens is fixed, but the mean of these two curvatures is arbitrary. When aberrations of the second order have to be included, the semi-cubical parabola is no longer a sufficiently close approximation to the caustic, which, in general, develops two new cusps off the axis. The general appearance of such a caustic was examined, as well as the possibility of deriving the two parameters from trigonometrically calculated rays. The authors urged that the full import of the higher-order aberrations could best be understood by an actual construction of the caustic in the several media, from which the trained optical calculator would be able to tell from the shapes of the successive curves how the aberrations of different orders would affect the final image formation, and also to form an idea as to which lenses were having most serious effect, and how changes in the forms of the lenses would enable him to diminish the spherical aberration of the final image.

PARIS.

Academy of Sciences, May 13.—M. Léon Guignard in the chair.—G. **Humbert**: The indefinite quadratic forms of Hermite.—J. **Boussinesq**: Further studies on the rupture of a sandy *terre-plein*.—H. **Le Chatelier** and B. **Bogitch**: The action of oxide of iron on silica. An experimental study of the penetration of silica bricks by oxide of iron. The iron penetrates more easily in a reducing atmosphere, the portions reached by the iron oxide contain less lime than the original brick, whereas the part of the brick not attacked by the iron oxide contains more lime than originally, the lime being expelled by the ferrous silicate and driven into the upper part of the brick. Four reproductions of photomicrographs are given, showing the condition of various zones of silica brick impregnated by oxide of iron.—G. **Julia**: Limiting values of Poisson's integral relating to the sphere and a point of discontinuity of the data.—E. **Belot**: The *rôle* of the forces dominating the attraction in the architecture of the earth and other worlds. Mechanical model of the formation of the solar system.—M. **Bied**: The function of the oxide of iron and lime employed as agglomerants in the manufacture of silica bricks. In studying the effect of different agglomerating materials in the manufacture of silica bricks an unexpected fact was elicited that appreciable quantities of oxide of iron, even in the presence of lime, do not appreciably lower the melting point of the brick. Further experiments on this question are now given in confirmation. In one case the addition of 3 per cent. of oxide of iron and 1 per cent. of lime lowered the fusion point only by 5° C., an amount not exceeding the experimental error.—E. **Rengade**: The composition of silica bricks taken from a Martin furnace.—Ed. **Chauvenet** and Mlle. L. **Nicolle**: The neutral zirconyl nitrate. There is no evidence of the existence of anhydrous or hydrated neutral zirconium nitrate. The hydrated zirconyl nitrate, $ZrO(NO_3)_2,2H_2O$, can be obtained as a crystalline product, but the anhydrous zirconyl nitrate could not be prepared from this.—M. **de Chardonnet**: Treatment of the wash waters in the manufacture of artificial silk. There are about 4 cubic metres of washing water (containing sulphuric and nitric acids, lime, and sulphur) per kilogram of silk produced, and it is necessary to neutralise this liquid before it can be run into drains or rivers. An arrangement is described for neutralisation with lime and removal of the precipitated sulphur. The liquors after neutralisation have marked manurial properties.—M. M. **Yélénko**: Results of studies on the earthquake of August and September, 1912, on the Sea of Marmora.—C. **Sauvageau**: The plantules of *Phyllaria reniformis*.—E. **Voisenet**: Is the Adamkiewicz reaction due to glyoxylic acid or to formaldehyde? Hopkins and Cole showed that the use of acetic acid in the Adamkiewicz reaction introduced a substance necessary to the production of the violet colour, and considered this to be glyoxylic acid. They considered the possibility of formaldehyde as the necessary reagent and rejected it. The author takes the opposite view, and regards formaldehyde, and not glyoxylic acid, as the essential reagent.

CALCUTTA.

Asiatic Society of Bengal, April 3.—Dr. T. **Kaburaki**: Zoological results of a tour in the Far East. Brackish-water Polyclads. The Polyclads described in this paper were obtained in brackish water in the north-eastern part of the Malay Peninsula. They belong to the genus Shelfordia, which has hitherto been known only from Borneo. It is the only genus of Polyclads that has been found in fresh water. Two new species are described.—Dr. N. **Annandale**: Zoological results of a tour in the Far East. Mollusca of the Tai-Hu. The Tai-Hu is a large, shallow body of fresh water occupying a depression in the alluvium of the Yangtse delta. Seventeen species of molluscs, of which three (all belonging to the family Hydrobiidæ) are now described as new, are recorded from it. One of the new forms belongs to the genus Hypsobia, Heude (which has recently been re-described by Robson under the name Katayama), another to Stenothyra, Benson, and a third to a remarkable new genus hitherto apparently confused with Vivipara, though actually belonging to a different family. The Tai-Hu molluscan fauna as a whole is remarkable for the small size of the individual and for the existence of an estuarine element in its composition.—Dr. N. **Annandale**: Zoological results of a tour in the Far East. Sponges. (1) Two marine sponges (*Reniera implexa* and a new variety of *Amorphinopsis excavans*) were found on the piers of a landing-stage some distance up a creek on the coast of Perak. They lived in very muddy water, and were exposed daily at the fall of the tide. The structural peculiarities which enabled them to exist in these conditions are discussed in detail. (2) Specimens of fresh-water sponges collected in Japan, China, and the Malay Peninsula are discussed and described. They include new species of Spongilla and Trochospongilla.—Capt. F. **de Mello** and Dr. J. F. St. A. **Fernandes**: Révision des champignons appartenant au genre Nocardia. In this paper the authors give a synoptical account of the numerous species of parasitic fungi belonging to the genus Nocardia. Our knowledge of these forms is at present in an extremely chaotic state, and the authors have attempted to introduce order and precision into the classification.—C. **Fischer**: Preliminary note on the flora of the Anaimalais. (i) General description of the tract; (ii) faunistic notes; (iii) jungle tribes and their cultivations; (iv) division of the vegetation into five types, description and characteristic species; (v) general conclusions and synopsis.—A. **McKerral**: The Burmese sesamum varieties. Notes on their variation and growth. After discussing the literature dealing with this crop and the importance of sesamum to Burmese agriculture, the author proceeds to describe the different varieties grown in Burma and their variations, using as a basis material collected from the principal sesamum districts and grown at the Talkon Agricultural Station. The description is followed by a tentative classification of the Burmese sesamums based on the branching habit, vegetative period, and colour of the seed, and by a discussion of the abnormalities which occur. In conclusion, the author discusses the possibilities of improvement, especially through single-plant selection.

VICTORIA.

Royal Society, March 14.—Mr. J. A. Kershaw, president, in the chair.—Prof. O. **Nordstedt**: Australasian Characeæ. This synopsis includes about fifty species of Chara and Nitella, one of Talypella, and one of Lychnothamnus, and was communicated by A. D. Hardy, who incidentally remarked on the over-production and subsequent decay of the species of Nitella in some Victorian reservoirs.—A. D. **Hardy**: Note on pentamery in Narcissus. The author described an inflorescence of "Soleil d'Or" (*N. tazetta*) in which five flowers were normal, the sixth having the floral formula of $K_5 C_5 A_5 + 5 G_5$. Careful search amongst many thousands of flowers of this species during the season failed to discover a similar specimen. The only other case of a similar kind known to the author was that of Crocus ($K_5 C_5 A_5 G_5$), quoted by Worsdell in "Principles of Plant Teratology."

BOOKS RECEIVED.

The Invertebrate Fauna of Nottinghamshire. By Prof. J. W. Carr. Pp. viii+618. (Nottingham: J. and H. Bell, Ltd.)

Manuale di Fisica ad uso delle Scuole Secondaire e Superiori. By Prof. B. Dessau. Vol. iii. Pp. vii+760. (Milano: Società Editrice Libraria). 23 lire.

A Handbook of Briquetting. By Prof. G. Franke. Translated by F. C. A. H. Lantsberry. Vol. ii. Pp. xi+214. (London: C. Griffin and Co., Ltd.) 15*s*. net.

"Inasmuch": Some Thoughts concerning the Wreckage of the War. By J. Oxenham. Pp. 26. (London: Methuen and Co., Ltd.) 6*d*. net.

Aids in the Commercial Analysis of Oils, Fats, and their Commercial Products. By G. F. Pickering. Pp. viii+133. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*. net.

Tropical Wild Life in British Guiana: Zoological Contributions from the Tropical Research Station of the New York Zoological Society. By W. Beebe. Vol. i. Pp. 504. (New York: Zoological Society; London: Witherby and Co.) 12*s*. 6*d*. net.

Practical Organic and Bio-Chemistry. By R. H. A. Plimmer. New edition. Pp. xii+636. (London: Longmans and Co.) 18*s*. net.

Tychonis Brahe Opera Omnia. Tomi Quarti. Fasc. Prior. Pp. 376. (København K.)

The Problem of Man's Ancestry. By Prof. F. Wood-Jones. Pp. 48. (London: S.P.C.K.) 7*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 30.

ROYAL SOCIETY, at 4.30.—A Method of Avoiding Collision at Sea: Prof. J. Joly.—A Statistical Survey of Colour Vision: Dr. R. A. Houstoun.—The Production of Anthocyanins and Anthocyanidins. III.: Dr. A. E. Everest.

ROYAL INSTITUTION, at 3.—The Abode of Snow; its Appearance, Inhabitants, and History: Sir F. Younghusband.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—The Cotton-mill Industry of India: Hon. Sir Dinshaw E. Wacha.

SATURDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—Problems in Bird-migration: Prof. C. J. Patten.

MONDAY, JUNE 3.

ROYAL GEOGRAPHICAL SOCIETY, at 5.

SOCIETY OF CHEMICAL INDUSTRY, at 7.30.—A Cadmium-vapour Arc Lamp: Dr. H. J. S. Sand.—The Estimation of Tin in High-grade Wolfram Ores and the Use of Lead as a Reducing Agent in Pearce's Assay: A. R. Powell.

VICTORIA INSTITUTE, at 4.30.—Germanism: Rev. Chancellor Lias.

WEDNESDAY, JUNE 5.

GEOLOGICAL SOCIETY, at 5.30.

ENTOMOLOGICAL SOCIETY, at 8.—Studies in Rhynchophora. IV. A Preliminary Note on the Male Genitalia: D. Sharp.

SOCIETY OF PUBLIC ANALYSTS, at 5.—A Method for the Colorimetric Estimation of Cobalt: E. G. Jones.—Nucleic Acid and its Analytical Examination: A. C. Chapman.—(1) Opium Wax. (2) Estimation of Morphine in Opium by Polarimeter: Jitendra Nath Rakshit.—The Application of the Valenta Turbidity Test to Mineral Oils: P. J. Fryer.—The Valenta and Crismer Tests: J. H. Johnston and Dr. A. W. Stewart.—A New Method of Identifying Starches: A. W. Blyth.—Two Plant Products from Colombia, S.A.: A. L. Bacharach.

THURSDAY, JUNE 6.

ROYAL INSTITUTION, at 3.—The Abode of Snow: Its Appearance, Inhabitants, and History: Sir F. Younghusband.

LINNEAN SOCIETY, at 4.30.—A Revision of Some Critical Species of Echium [Viper's Bugloss], as Exemplified in the Linnean and other Herbaria, with a Description of *Echium judaicum*, a New Species from Palestine: C. C. Lacaita.—Experiments with Cyclamen: Capt. A. W. Hill.—The Relationship between the Symbionts in a Lichen: R. Paulson and S. Hastings.—Abnormal Apple-blossoms and Fruit: W. C. Worsdell.

FRIDAY, JUNE 7.

ROYAL INSTITUTION, at 5.30.—The Romance of Petroleum: Sir B. Redwood.

SATURDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—Problems in Bird-migration: Prof. C. J. Patten.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, JUNE 6, 1918.

SYMMETRY IN NATURE.

Lectures on the Principle of Symmetry and its Applications in All Natural Sciences. By Prof. F. M. Jaeger. Pp. xii+333. (Amsterdam: "Elsevier" Publishing Co., 1917.)

THIS is a book of unusual character, written by a Dutchman, Dr. F. M. Jaeger, professor of inorganic and physical chemistry at the University of Groningen, Holland, who is personally known to many English and American men of science from his visits to this country and the United States, and who is not only a chemist, but also, what is infinitely rarer, an accomplished crystallographer. Although published in Amsterdam, it is written in the English language, and dedicated to an Englishman, the president of the Chemical Society, Prof. W. J. Pope.

These alone are reasons why a welcome should be given to the book; but its own merits are also adequate to deserve it. The author is well known for his researches on enantiomorphism and optical activity, for his crystallographic investigation of the hexagonal ethyl sulphates of the rare earths and other substances, and most recently for a series of beautiful photographs of Laue X-radiograms taken with the crystals of a considerable number of important substances. Prof. Jaeger is obviously a great admirer of the work of Prof. Pope, for which the latter received the Longstaff medal of the Chemical Society, on the relation between the crystal form of optically active substances and their chemical nature, on the true character of a racemic substance as a molecular compound of the two optically active antipodes, and of a pseudo-racemic substance as an intimate, exceedingly fine, alternating repetition of the two varieties, and his work generally in confirming Pasteur's law.

The most important section of the book, its latter half, is devoted to an excellent summary of these investigations and those of other workers in this domain, together with their relation to the theories of van't Hoff and Le Bel concerning the asymmetric carbon atom, and to the further work of Pope and Kipping on the asymmetric atoms of nitrogen, sulphur, selenium, tin, silicon, and phosphorus. Practically everything that is surely grounded in chemical crystallography is clustered around the two subjects of enantiomorphism and isomorphism, and it is the former only that is dealt with in this book, the latter being scarcely touched, which is somewhat of a disappointment.

In yet another aspect, however, the book is remarkable. It deals with the principle of symmetry, applied so generally as to include the animal and vegetable kingdoms as well as crystals. One of the happiest features is the excellent photographic figures of highly symmetrical living objects, such as radiolaria, *Circoporus octahedrus*, *Circorhegma dodecahedra*, *Circogonia icosahedra*, pollen seeds, fruits, and especially flowers. Indeed, the amount of ground covered is well-nigh bewildering. The first four chapters deal with the nature, æsthetic value, and laws of symmetry; with the deduction of symmetry character as a mathematical problem; with mirror-image repetition by reflection and inversion; with the derivation of the possible types of symmetry by the method of groups of movements; and with the applications to the morphology of crystals, plants, and animals.

Chap. vi. is omnivorous, for it deals with the systems of crystal symmetry, the derivation of the 230 types of homogeneous crystal structures and of the thirty-two classes into which they fall, including the fourteen Bravais space-lattices, the sixty-five regular point-systems of Sohncke, and the methods of Schönflies, Federov, and Barlow for deriving the rest of the 230 types by use of mirror-image repetition; with the space-lattice in relation to Hauy's law; with the Barlow-Pope valency volume theory; with the diffraction and reflection of X-rays by the planes of atoms in crystals, and the X-ray analytical methods of Laue and Bragg; with the existence or otherwise of chemical molecules in crystals; with Werner's co-ordination theory; and in conclusion with phyllotaxis, the symmetrically spiral arrangement of the leaves of plants. It is, however, in the latter part of the book, and especially in the two chapters on Pasteur's law, that the author is at his best. He concludes with some valuable suggestions for further research, especially as regards the premier problem of bio-chemistry, the asymmetric synthesis of organic molecules.

It is interesting that Prof. Jaeger does not commit himself to a definite opinion concerning the Barlow-Pope valency volume theory, although he points out that the X-ray work has not afforded any support to the theory, and he clearly perceives the futility of tampering with axial ratios. As regards the persistence of the molecule in the crystal, one is glad to see that the author agrees that geometricians have gone too far in deleting the molecule as an entity in the solid crystal, for he rightly points out that although the crystal structure is essentially one of atoms, still the molecule remains in position, and unless its entity be admitted, all kinds of difficulty arise as to valency, interatomic forces, enantiomorphism of the chemical molecule, effect of solution, and so forth, all of which are insoluble on the purely atomic assumption.

As above mentioned, isomorphism is not dealt with, doubtless because the symmetry remains the same in all isomorphous substances. Consequently the law of progression with atomic number, of the crystal angles, elements, and physical constants, in such series as the rhombic sulphates and selenates of the alkalis and the monoclinic double sulphates and selenates containing $6H_2O$, now so thoroughly established and so perfectly explained by Moseley's law connecting the atomic number with the complexity of the atom, is not referred to. Yet in the writer's opinion it forms a very beautiful addendum to Prof. Jaeger's principle, especially as these regular differences become smaller as the symmetry becomes higher, until in such series of relatively high symmetry as the hexagonal ethyl sulphates of the rare earths investigated by Prof. Jaeger they are reduced almost to the limits of experimental error, while in the cubic system they disappear altogether. One statement made by the author can scarcely be accepted, that isomorphism is only a special case of morphotropy. For in an isomorphous series the space-lattices, and therefore the volumes and edge-dimensions of their cells relatively expressed by the molecular volumes and topic axes and confirmed by absolute measurement by X-rays, are strictly comparable, whereas the cells of morphotropic substances are not at all necessarily comparable, and, in general, are probably not so.

Some of the drawings could well be improved, but the photographic figures of biological objects and X-radiograms are excellent. Before another edition is printed numerous slight errors in English and spelling should be eliminated with the aid of some English friend. The author's power of expressing himself in our language is, however, surprising, and often truly excellent.

The book is an inspiring one, and well worthy of the attention of both chemists and biologists. If stereochemists had all been forced to take an elementary course of crystallography they would have avoided much of the acrimony of the long-drawn-out discussion over asymmetric atoms, the exact conditions being plain; and they would have recognised right away that the presence or absence of a plane of symmetry is not the test for optically active enantiomorphism. The reason why Prof. Pope's work in this domain is so well grounded, and why we listen also to Prof. Jaeger with such confidence, is that both are not only stereochemists, but also practical crystallographers. The moral is clear.

A. E. H. TUTTON.

ELECTRICITY METERS.

Electricity Meters: their Construction and Management. A Practical Manual for Central Station Engineers, Distribution Engineers, and Students. By C. H. W. Gerhardi. Second edition, revised and enlarged. Pp. xx+504. (London: Benn Bros., Ltd., 1917.) Price 15*s.* net.

THE function of an electricity meter is to make an accurate record of the energy expended in a consumer's appliances. The principles on which it works are well known, but without having recourse to the integral calculus it is difficult to explain how it fulfils its functions. On p. 3 of this book, for instance, the author has to explain that what it measures is the integral of the product of two functions of the time, namely, the pressure and the current. In fact, an electricity meter is a most wonderful calculating machine, which has been gradually evolved by the joint labours of mechanical inventors, electricians, and mathematicians. Although it is generally placed in some out-of-the-way position, where it is looked on with disfavour by the domestics, yet it performs its wonderful operations with the highest accuracy from year to year. Manufacturers also turn out many thousands of "tariff" meters—that is, meters which will let you have a cheaper supply at one period of the day when the demand is small, and a dearer supply at the times of the "peak" load. In addition, many thousands of penny, sixpenny, and shilling "in the slot" meters are in daily operation. In nearly all cases when the electricity paid for is exhausted, the lights go out, but in some cases an intolerable blinking of the lights occur. As more than one coin can usually be inserted in a meter, there is a dial showing the number of "unconsumed coins" remaining in it.

One good effect of the lighting restrictions will be that it will make many householders read their meters once a week. When they have mastered this accomplishment it will begin to dawn on them what an admirable servant an electricity meter is. If they are skilled observers they may be able to detect slight differences in its rate, but unless they are very skilled, or the meter does something outrageous, it will not be safe to dispute the reading with the supply company. From a long experience of "disputed" meters the writer finds, from his official tests, that only about 10 per cent. of them are outside the limits of permissible error. He has known, however, a meter where the thousand dial of the cyclometer counting train made a jump of 2000 units instead of 1000, and yet on inspection of the train and on an official test over the disputed part of the dial it behaved normally. The consumer, however, being a careful man, entered the weekly readings in a book, and thus proved conclusively its nefarious deed. A flaw in the mechanism, discovered later, proved how it happened.

The most difficult errors to detect in meters are in connection with the wheel train. Sometimes it requires more power to turn it in certain positions of the dials than in others, and tests to detect this fault are difficult to devise. In the study of friction losses great progress has been made. These losses are due to the commutator brushes (which are sometimes made of gold), the bearing, the gearing, and air friction. The friction of the bearing and gearing is practically constant at all loads. The brush and air friction increase with the load, and, therefore, with the speed of the spindle, but the latter does not obey the parabolic law. In some cases the total friction torque appears to attain a minimum value at low speeds. When the spindles are supported by cupped diamond bearings the bearing friction is very small. Sometimes it is eliminated altogether by keeping magnetically the rotating part floating in the air.

This book should prove most useful for those for whom it is written. The practical hints given in the chapters on "Choice of a Type of Meter" and on "Meter Testing" are good. The diagrams in the latter chapter are worthy of commendation. Several of the meter illustrations, however, are very poor, and could have been omitted with advantage. The author refers throughout to the kilowatt-hour as the B.T.U., which is a contraction for the Board of Trade (electrical) unit. It is therefore liable to be confused with the British thermal unit (B.Th.U.). In this edition a new chapter on polyphase meters and the measurement of polyphase power has been added, all the well-known mathematical theorems being clearly given. We sometimes wonder whether these theorems will be included in the school studies of the coming generation. A. RUSSELL.

NATURAL HISTORY OBSERVATIONS.

The Young Observer's Handbook. By W. P. Westell. Pp. 317. (London: McBride, Nast, and Co., Ltd., 1918.) Price 7s. 6d. net.

THIS book will be useful in giving practical hints to young observers who have the root of the matter in them. It gives hints about collecting, preserving, and mounting; about microscopic work and photography; about keeping pets and making little museums; about aquaria and vivaria. It also suggests how the young naturalist may set about exploring shore-pools, ponds, and other haunts of life; or how he may make much of the wild life of a garden. On the last topic we have the best part of the book. The idea of providing an all-round introduction to practical Nature-study is good; the mood of the book is wholesome; and the text has been kept simple. We are sorry to have to say that the style is easy-going and inelegant. But there is in Mr. Westell's work an enthusiasm for Nature-study that inclines one to forgive a good deal. Young observers will find in the book many suggestions which will make them more efficient, but we think and hope that they will, even when grateful, resent the author's tendency to "talk down" and his not infrequent wordiness.

The book is liberally illustrated with one hundred and fifty photographs, diagrams, and sketches, many of which are of much interest. We wish Mr. Westell's standard of precision and accuracy had been higher, for it is by example as much as by precept that young observers learn that they can never go far unless they are doggedly precise and accurate. Besides a frequent vagueness in the book, there is a lack of carefulness, which is regrettable. Thus the figure of a so-called Nautilus is quite wrong. It is a fictitious Nautilus, which should not have been allowed to figure in a scientific book. It is, we think, a pity to tell boys and girls that "newts pass through a similar metamorphosis to their relatives, the frogs and toads. They also have, like them, a supplemental breathing apparatus when grown up, consisting of pores in the skin." Many other examples might be given. Changing the subject a little, we do not think that it profits much to write: "I do not know that it matters whether the young naturalist should be aware of the fact that some fishes have teeth, whereas others are toothless. We do not judge a man or woman, a boy or girl, by being toothless. We judge him or her by the life that is led, and as such we may also judge fishes." But this Daniel come to judgment has not judged rightly in including in his handbook for young observers, with a delightful "foreword" from Marcus Aurelius (to which name the author characteristically adds "Antonius"), three lists of the old horrors of connate leaves, ochreate stipules, runciform shapes, æterio of follicles, and the regma.

OUR BOOKSHELF.

A Flora of Epsom and its Neighbourhood. By the Rev. T. N. Hart Smith-Pearse. Pp. ix+107. (Epsom: L. W. Andrews and Son, 1917.) Price 3s. 6d. net.

THE late Headmaster of Epsom has worthily carried on the traditions which he established at Marlborough, and in his flora of Epsom and the neighbourhood has produced a very useful little book.

The flora, which includes a good map of the district, is the outcome of observations made between the years 1889 and 1914 by Mr. Hart Smith-Pearse and masters and other members of the Epsom College Literary and Scientific Society. The account suffers a little, no doubt, owing to the absence of records during school vacations in April and August, not so much in the omission of plants, perhaps, as in the records of the first flowering of certain species.

These records of the earliest and latest dates of flowering are a valuable addition to the flora, and a particular feature of the natural history work, both at Marlborough and Epsom.

The London Catalogue is followed as regards specific names and the numbering of the orders and genera, and in comparison with the Catalogue for 1908, it is noted that twelve orders and 184 genera are not represented in the flora.

The interest of the book is enhanced by the attempt which has been made to give the derivation of each generic name. It is unfortunate that in the case of names from the Greek, the Greek word is not given as a guide to the pronunciation. The author has, however, taken care to accent all the names, and we hope that some day the proper pronunciation of cle′matis will become general.

As to Fumaria, we believe the name to have been used with reference to the resemblance of the grey-leaved plants to smoke issuing from ground, rather than to the smell of the plants. Certainly the old authors referred to the fumitory as *fuma terrae*.

The study of natural history as fostered by the Rev. T. N. Hart Smith-Pearse, both at Marlborough and Epsom, is of the utmost value, as boys who have learnt how to observe, thanks to the traditions he has established, well realise. As an old Marlburian, the writer fully agrees that field botany, properly studied, will not fail to bear fruit in after years. "It is," as the author says in his preface, "a branch of education which it is foolish to neglect, for it may often lead a boy to find his true career, and seldom fails to add to his future happiness and enjoyment." A. W. H.

Transmission Gears, Mechanical, Electric, and Hydraulic, for Land and Marine Purposes. By E. Butler. Pp. xii+164. (London: Charles Griffin and Co., Ltd., 1917.) Price 8*s.* 6*d.* net.

THIS book is intended for engineers engaged in the application of internal-combustion engines for automobile, marine, and other purposes, and provides a fairly exhaustive treatment of friction-clutches, change-speed gears, and reversing methods. The book contains a large number of illustrations taken from working drawings; these drawings, together with the accompanying descriptions, constitute the most valuable part of the work, and should be very useful from the designer's point of view. The author is by no means so happy in the sections introducing calculations, and in some parts has produced so much confusion as to render these portions almost unreadable. Thus the terms "torque" and "driving effort" have entirely different meanings, but the author uses them indiscriminately in his calculations on friction-clutches. The result is that there are many errors in this section of the book, which should be revised thoroughly in the second edition. Further, calculations which "run on" in the text are difficult to follow; these are much more likely to be read and understood if displayed properly. There is also need for the introduction of clear methods of calculating epicyclic gears; those given are not likely to be of much assistance to the designer. As stated above, the value of the book consists in its collection of working drawings, and its value could be greatly enhanced by thorough revision.

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.*]

Construction for an Approximate Quadrature of the Circle.

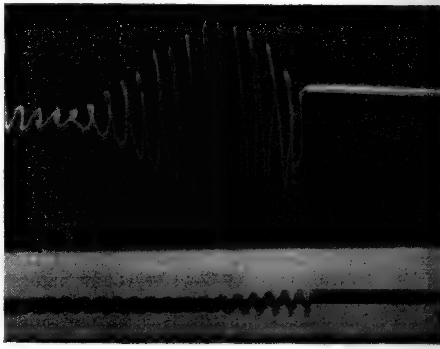
DR. ROUSE BALL's interesting account, in NATURE of May 23, of M. de Pulligny's constructions reminds me of another simple one which I do not think known. If OA, OB are perpendicular radii of a circle of radius 1, and if BCD is a line cutting OA in C and the circle in D and representing the side of the square in question, then $OC=\sqrt{(4/\pi-1)}=0{\cdot}52272321$, which, put into the form of a continued fraction, has for convergents $\frac{1}{2}$, $\frac{11}{21}$, $\frac{12}{23}$, $\frac{23}{44}$, $\frac{2910}{5567}$, etc. The convergent $\frac{23}{44}$, or 0·52272727, differs (in excess) from the real magnitude only by 1 in 128750; hence if we take C such that $OC=\frac{23}{44}OA$, which can be done easily and with great accuracy, the line BCD represents the required side with all the accuracy which any graphic construction can be expected to give. Theoretically, this method is 121 times more accurate than M. de Pulligny's construction with the Archimedes ratio, but thirty-seven times less accurate than that with the Metius ratio. In practice, however, this relative inaccuracy is absolutely unnoticeable, and the method here described is the easier to carry out.

ROBERT E. BAYNES.

Christ Church, Oxford.

The "Wolf-note" in Pizzicato Playing.

THE accompanying photograph, showing the simultaneous vibration curves of the G string and bridge of a 'cello played *pizzicato* at the "wolf-note" pitch, presents some noteworthy features which may be of interest to readers of NATURE. One of the striking features is the extremely rapid dissipation of energy. The other feature is the effect of the motion of the bridge on the vibration of the string. The photograph may, in fact, be briefly described as showing a strongly



damped *coupled* vibration of the string and bridge, in many respects differing from the cyclical vibrations excited by *bowing* at the "wolf-note" pitch described by me in previous communications to NATURE. At pitches slightly different from that of the "wolf-note," the dissipation of energy is far less rapid, and the motion of the string approximates to that of an ordinary damped harmonic vibration.

C. V. RAMAN.

Calcutta, April 12.

The "Hay-box" Principle in Cooking.

IT happened last week that about 1 lb. of fresh lamb was put into an oven at night in order that it might be cooked by morning on the "hay-box" principle. It was in a casserole, with a little water. Similar treatment in the same oven on previous occasions had been very successful. At about 5 a.m. the casserole was examined, and the broth was found to be very well tasted, and the whole smelt fresh and good, but the meat when tested with a fork was not tender, and the fat (of which there was a good deal) was *entirely* unmelted. The casserole was returned to the oven (then quite cool) and taken out again after breakfast. The contents were then found to be smelling most offensively, as if extremely "high." The fat was melted. The meat and broth were judged quite unfit for human food.

I wonder if any of your readers would explain this curious development.

AN INQUIRER.

May 30.

British Oligochæt Worms.

I AM now engaged on the MS. of my monograph of British Oligochæts for the Ray Society. The first volume will be devoted to the Enchytræids or white-worms. Though the country has been well worked, no doubt there still remain indigenous species which have not yet been recorded; and I shall be glad to aid other workers in making them known.

HILDERIC FRIEND.

Cathay, Solihull, Birmingham.

THE POSITION OF NATURAL SCIENCE IN THE EDUCATIONAL SYSTEM OF GREAT BRITAIN.

THE report of the Committee appointed by Mr. Asquith when Prime Minister in August, 1916, has recently been issued, and a summary of its conclusions appeared in Nature for April 18. The chairman of the Committee was Sir Joseph J. Thomson, president of the Royal Society, and now Master of Trinity College, Cambridge. In an article on the report the *Times* hinted that the Committee included too large a proportion of men of science to yield conclusions entirely free from bias. There is no justification for such suspicion. The report was unanimous. Apart from members representing industry and business, and several with large experience of educational organisation, not fewer than six possessed a practical acquaintance with teaching, acquired as masters in public schools; and one of these, now a headmaster, was formerly a classical master at Clifton.

Whatever view the reader may take of the questions involved in the business of the Committee, he will find that the introduction to the report contains interesting reading and expressions of sentiment in reference to the value of literary and historical studies which ought to be satisfactory to every reasonable person. There is no sign of prejudice here. But there is probably no department of human activity in which it is more difficult to bring about a change of opinion than in connection with education. It is more than a century since the Rev. Sydney Smith poured the burning satire characteristic of his wit on the classical pedantry of his day, which forbade the mere mention of such subjects as political economy, much less the various divisions of physical science, as worthy of notice in a university. It is more than fifty years since the Duke of Devonshire's Commission recommended that all boys should receive instruction in some branch of natural science. Nevertheless, while undoubtedly great advances have been made of late years, it is even now impossible to say that all the secondary schools in the country are free from the prejudicial influence of the exclusively literary form of education in which the majority of schoolmasters have been brought up. There is too much of the attitude of the young man in the parable who said to his father, "I go, sir," and went not. There are great schools still which boast that they are teaching science, while their pretensions are shown to be hollow by the totally inadequate allowance of time assigned by them to science subjects, and by the fact that many of the literary specialists among the boys escape altogether.

Just now, as remarked by the Committee, the war has led the nation to perceive something of its deficiencies in the matter of science, and everyone is ready to receive science with open arms. "Just now it seems unnecessary to take action to ensure against any relapse into the old conditions, but experience of the past shows us that temporary enthusiasm needs to be fortified by some more binding material."

What, then, ought to be done? The Committee has provided a summary of the principal conclusions. These conclusions are gathered into eighty-three short paragraphs. They are obviously not all of equal importance, and, of course, they apply to various kinds of school and to the needs of various callings.

First and foremost the recommendations that all schools should be subject to compulsory inspection, and that this inspection should be under the direction of the State, will find few to raise objections. The work need not be done wholly by inspectors from Whitehall, for the universities, more numerous and active than formerly, have already considerable experience in this direction. And it is only when a little light is thrown into the dark places and a little pressure put on that governing bodies and headmasters will see what is their duty in this connection. This consideration suggests another reform which is not referred to by the Committee, and that is the desirability of some control of the constitution of governing bodies of schools. In some cases local tradesmen are put on with the object of representing ratepayers who object to the cost of education. In other cases the vicar of the parish is a member and often the chairman of governors, no matter what his qualifications for dealing with educational matters. Others, again, notably some of the most famous schools, are under the control of bodies containing far too large a proportion of clerical members, whose attitude towards science is for the most part as conservative as it was forty years ago.

The report is emphatic in the conclusion that more time must be given to science in all schools, for girls as well as for boys. At the present time and for some period after the war there is a practical difficulty about carrying this into effect, owing to the scarcity of teachers. But this will have to be altered by making the profession more attractive both in regard to salary, prospects, and pension, and, as pointed out by the Committee, in the attitude of the public towards the use of education and the importance of the training of teachers. Every teacher agrees that lessons in natural science are effective only when the pupil is required to do some kind of practical work for himself—that is, to handle materials and make observations and experiments on them. For this purpose a room must be set apart which provides plenty of light, a water supply of a suitable kind, convenient methods of applying heat, and so forth. It must also be furnished with some apparatus, especially balances for weighing. In fine, what is commonly called a laboratory must be provided. Fifty years ago or later a few great schools had their laboratories, plainly though sufficiently equipped. Now some of these schools have run into what must be regarded as extravagance in this direction. Their laboratories are fitted with every modern convenience, and are equal in elaboration to anything which might be expected in a university. The idea of providing labour-saving appliances may be carried too far in the laboratories to be occupied by junior students. When everything is "laid on" and it is only necessary to turn a tap, opportunities for the exercise of ingenuity and dexterity, as well as the acquisition of useful practical knowledge, are lost. The young student should be encouraged to make many things for himself, starting with glass and rubber tubing, wire, sealing wax, etc.

The provision of school laboratories has gone on very rapidly during the last twenty years, and it is probably in girls' schools chiefly that it is least satisfactory. The Committee very wisely points out that in planning new schools it is much more important to secure ample space than to provide elaborate and costly fittings. There is a large number of private schools, chiefly for preparatory and cramming purposes, which have no provision for practical work, and how to deal with these people is not very clear while the parents are so ignorant and display so much indifference. A proper inspection system would probably have the effect of squeezing some of them to death, which would on the whole be an advantage to the country.

One other point may be mentioned relating, not directly to the pupils, but to the teachers. While it is certainly necessary to hold out to the teaching profession more liberal inducements to take up this kind of work, a higher standard of efficiency will reasonably be demanded of teachers. The Committee recommends that short courses of training should be established for teachers, which apparently they think should be taken concurrently with other studies, and not at the end of their course. This recommendation ought undoubtedly to be adopted by all who propose to become teachers in schools where the students are all beginners. A young man or woman may be full of knowledge without the least idea of the best way to reach young minds, and a few months devoted to the study of method will be found advantageous to everyone. The prospective teacher may have attended the systematic course of a professor at the university, but he ought not to proceed to imitate this in his dealings with boys and girls. At the same time, he ought to be cautioned against faddists and educational quack doctors, but should be led to examine his own stock of knowledge and experience, and ask himself how best he can make it attractive and useful to others. After one or two experiments each one will find out for himself how best to accomplish this, and to awaken in others an interest in the subject taught. Some freedom in this process ought to be allowed by headmasters and inspectors. Very valuable work in the way of suggestions to teachers of various subjects, both physical and biological, has been accomplished by the Association of Public School Science Masters and the corresponding Association of Science Mistresses, and attendance at the annual meetings of these bodies, which would probably be open to non-members, would be certain to be full of interest and instruction to young teachers.

W. A. T.

SCIENCE AND ADMINISTRATION.

THE growth in the magnitude and in the complexity of modern industrial and commercial undertakings has in recent years caused attention to be directed to the methods of management in connection therewith, and a vast amount of knowledge on the subject has been accumulated, co-ordinated, and arranged. In consequence, a great volume of literature, constituting the science of administration, has been brought into existence. To this an interesting addition has very recently been made by the publication in the number for the first quarter of 1918 of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* of a paper read by M. Fayol on November 24, 1917, in Paris on "L'importance de la Fonction Administrative dans le Gouvernement des Affaires." We learn therein that the Société des Ingénieurs civils de France has recently made a strong recommendation that courses of instruction on "administration" shall be introduced forthwith into all the higher schools of civil engineering in France. M. Fayol, on the occasion mentioned, expressed a hope that instruction in this subject might be made part of the curriculum of every school in France, even a part of those of primary schools; he is convinced that widespread instruction in "administration" must result in immense benefit to the French nation.

A knowledge of scientific methods of administration and the application of the principles thereof in the domain of private undertakings, as well as in that of State enterprises, are matters which possess the same importance in these islands as they do in any other part of the world. There is reason to believe that this is fully appreciated in our business circles, and to this is it due that, at centres where courses of instruction are given in subjects connected with "administration," those responsible for the conduct of important undertakings encourage their employés to attend such courses, and even give them facilities for the purpose. But, unfortunately, a similar attitude does not prevail in our Government circles. Not so many years ago the head of one of the branches of a Government Department put forward proposals in connection with the institution of special courses of instruction in administrative subjects for the officers of his branch. The Minister in charge of the Department received the suggestion sympathetically; the officials of the London School of Economics were accommodating and took great pains in preparing a scheme for the purpose; however, the permanent officials of the Department were passively hostile. The subject remained under discussion for a very considerable time, but eventually was allowed to drop. Naturally, no official reason was given why the proposal met with such a fate; possibly the permanent officials were opposed thereto for the reason that, in their opinion, the institution of the proposed courses would have made the branch in question "too strong"—that is to say, *too efficient*.

It would almost appear as if the attempt to attain such a result in the public services was regarded as a most reprehensible act. Yet it must be evident that, before scientific methods can be put into practice, such methods must be learnt and understood; also that individuals in the public services are no more capable of acquiring such knowledge by mere intuition than are those employed in civil life. Further, it is generally recognised that the days have long gone by when boldness in enterprise can make up for the lack of systematised knowledge and method, whether in the industries and in commerce, or in the domain of State activity, in diplomacy and in war.

The science of administration is concerned alone with those lessons which teach how the highest state of efficiency can be secured in the enterprises with which men busy themselves; the principles involved therein lie, as M. Fayol reminds us, within a narrow compass. "Administration" is neither an exclusive privilege nor a personal quality of those controlling or managing an undertaking or enterprise; it is really a function which, like all essential functions, comes into play between the head and the members of a body corporate. It must be distinguished from management, which is a *rôle* concerned with the care and skilful conduct of the whole of an enterprise, a *rôle* that must provide for the efficient performance of the following essential functions—namely, the administrative, technical, commercial, financial, that of custodianship and that of book-keeping.

Although "administration" is only one among the above six functions, nevertheless it demands that foresight, efficient organisation, co-ordination, and control shall prevail throughout the enterprise or undertaking, and it comes into play not only in the enterprise or undertaking as a whole, but also in every part and in every operation thereof.

Most powerful aids to efficient administration exist in "Taylorism" and in a sound organisation within the enterprise or undertaking; the former concerns the "science of efficiency" in relation to the individual; the latter concerns the same "science" in relation to the body corporate.

"Taylorism," or *chronométrage*,[1] consists in the determination of factorial values in time units for each item of the work of individuals when performed in the most efficient manner human beings are capable of. Such values can be ascertained in relation to every branch and item of human activity, and, when properly applied, afford an unsurpassable check, of a preventive and anticipatory order, against waste of human effort.

Organisation consists in the proper subdivision of the work of an enterprise and in the most effective employment of the *personnel* necessary to carry it on. The principles involved are few in number, but no single uniform organisation can be devised which will suit the varying requirements of every undertaking: each must be provided with an organisation specially designed in relation to the nature of the operations that have to be conducted therein.

In the case of private undertakings the instinct of self-preservation is an impelling force, and, in consequence, they are, as a rule, provided with a sound and efficient organisation. On the other hand, in the case of the public services artificial conditions, as a rule, prevail, and the question of the survival of the fittest is not a troubling factor; in consequence, State undertakings are often provided with an illogical or unsound organisation.

Strange indeed are the ways of political reformers who concern themselves with State organisation and administration. In recent years, by a curious irony, struggles were started about the same time of a nature that whereas one State, which possessed an admirable organisation, might have been seen attempting to abandon the same for one less efficient, another State, which had become tired of inefficient methods, might, on the other hand, have been seen endeavouring simultaneously to introduce industrial conditions into its public services; these struggles were witnessed, in 1912, in Sweden and Italy, and arose in consequence of the reports of Royal Commissions.[2]

Sweden, at that time, possessed an old-established organisation in its public services—one that was brought into existence, in 1634, by that great administrator, Oxenstierna, who had fixed with precision the powers of the great Departments of the Swedish Government and had vested the management of State undertakings in Administrative Boards, whereon both technical and administrative officials serve. Even the Commission that recommended changes in the well-tried State organisation of Sweden—changes which are, in the opinion of the well-informed, likely to introduce a bureaucratic encumbrance and political mismanagement in Swedish State undertakings of a technical character—has spoken favourably in its report of these Boards: it has stated that the independent position occupied by the Administrative Boards has in the past proved a considerable safeguard and had acted as a powerful element in contributing to the smooth working of the State machinery, whilst providing a powerful incentive towards progressive ideas.

Italy, on the other hand, at the period in question possessed an organisation in its public services scarce half a century old, an organisation which

[1] The invention of Mr. F. Winslow Taylor, of the Bethlehem Steel Co., U.S.A.

[2] (1) "Departementalkommitterades Betänkande." (Stockholm: H. L. Beckman's Boktryckeri, 1912.) (2) "Commissione Reale per lo Studio Technico, Amministrativo e Finanzario del Servizio Telefonico in Italia." (Rome; Tipografia dell' Unione Editrice, 1911.) (3) "Commissione Reale per il Riordinamento dei Servizi Postali e Telegrafici." (Rome: Tipografia ditta Ludovico Cecchini, 1912.)

suffered from the exigencies of political jurisdiction and, to some extent, from the mischief of bureaucratic control. At Rome, too, policy and technical Boards were in existence in connection with the public services, but these Boards occupied only a consultative position. Italy, in the struggle mentioned, was desirous of emancipating its public services of a technical nature from political influences and the incubus of bureaucracy, and substituting therefor an industrial organisation and commercial methods of administration.

It is not surprising, then, that M. Fayol should have told the Paris audience to whom he addressed himself in November last that only those who possess technical and administrative ability combined are really capable of laying down scientific methods of administration and of erecting the framework of a scientific organisation. No practical person familiar with the requirements of modern technical enterprises is likely to quarrel with him for holding this view. It must be evident even to the most casual observer that we have now reached a stage in industrial development such that, in order to obtain the fullest measure of success from human effort, it has become imperatively necessary to secure from men possessing scientific attainments and a technical training the highest degree of co-operation in the administration and management of technical enterprises, whether privately owned or in the hands of the State; further, that any attempt to divorce the administrative from the technical control in such enterprises is mischievous, and must, if persisted in, eventually lead to national ruin.

W. A. J. O'MEARA.

"AFTER THE WAR."

THE final report of the Committee on Commercial and Industrial Policy after the War has now been issued; it necessarily deals with such a vast number of complex subjects that it has perforce to content itself with generalities, more or less vague, and gives but few indications upon which any definite line of policy can be based. It is notably weak in what should, perhaps, have been its most important inquiry—namely, as to the utilisation of the natural resources of the Empire to the best advantage in the future; it is significant that the title of the Committee is "on Commercial and Industrial Policy," instead of "on Industrial and Commercial Policy," as it logically should have been, seeing that a sound commercial policy can only be developed upon lines following industrial development, and not *vice versa*.

In most cases this Committee has merely summarised the reports of various Departmental Committees, without giving any indication of the relative importance of the subjects discussed. For example, the coal trade is thus briefly dealt with, and there is no indication in the report to what an overwhelming extent this is the essential industry upon which our Empire depends. Mr. Scoby Smith has, indeed, appended a very valuable note upon the importance of conserving our supply of coking coal, but even this does not touch the larger question. Coal plays, in fact, a twofold part; not only is it the raw material from which a host of important industrial and pharmaceutical products may be obtained, but, above all and beyond all, it is also practically the sole source from which we draw our mechanical energy. Without a continuance of the supply of abundant and relatively cheaply won coal that we have hitherto enjoyed, the industrial supremacy of Britain would be gone, and we should rapidly fall to a very subordinate position amongst nations. It is scarcely too much to say that the magnitude of this problem completely overshadows all the others; if the whole of the recommendations put forward by the Committee could be acted upon, and if they all produced the maximum of good effect that the most sanguine member of the Committee could expect, they would be powerless to save Great Britain from industrial ruin if she could no longer produce an abundant output of coal as cheaply as her competitors. The Committee does not appear to have realised that such coal production is the most urgent and the most vital of all after-the-war problems.

There are, it is true, some recommendations as to mineral production in general which naturally do include our coal production. Thus the Committee strongly recommends an intelligence and advisory bureau for dealing with metals and minerals, and a special letter from the chairman of the Committee to the Premier emphasises this recommendation, and supports the resolution of the Imperial War Conference to the effect that an Imperial mineral resources bureau should be established in London. It is satisfactory to know that such a bureau is in process of formation, and the general tenor of the Committee's views on the subject would seem to be quite sound, especially in respect of the principle which is laid down—that the functions of the bureau should be the dissemination of intelligence and advice, but be in no sense executive; and, further, that the utmost use should be made of the services of technical and scientific experts. The value of such a bureau to the mineral industries of the Empire should be very great, and its suggested activities are exactly what is required; hitherto the assistance that the coal-mining industry has received from the Governmental authorities has been essentially of the negative order.

Our mining engineers can be trusted to work out their own problems for themselves, as they have always done, but the increasing complexity of mining methods demands a far better supply of official information than has been forthcoming up to the present. It is only necessary to compare our meagre Home Office annual reports with the splendid volumes of the Prussian *Zeitschriften* to realise how greatly we have been handicapped in this respect. Of all national resources, mineral resources need the most scientific study, the most complete utilisation, and the most careful conservation, because, unlike other natural resources, they are not reproductive, and, once used, they can never be renewed. On all grounds the creation of such a bureau as has been advocated by the Committee is to be heartily welcomed by the mining community, and it ought to play a leading part in co-ordinating the utilisation of our mineral resources after the war to the best advantage.

It is doubtful whether other recommendations are likely to be quite so successful in every case, and in some instances they scarcely appear to have been sufficiently thought out. Thus one of the suggestions is the creation of a statutory tribunal to enforce the granting of wayleaves where unreasonably withheld. There is no doubt that wayleaves do in many cases press unduly and unfairly upon the mineral producer, but the proper remedy is a modification of the whole system rather than a palliative to be applied only to cases where wayleaves are refused. At present any landowner is at liberty to make whatever charge he thinks fit for a mineral wayleave across his land, and his method is to base his charges upon the presumed needs of the miner. A simple legislative enactment that the measure of a wayleave rental should be, not the necessity of the miner, but the amount of damage suffered by the landowner, is really what is required. There would be no difficulty in finding a tribunal capable of properly assessing such damage, and it cannot be fairly urged that such a system would be inequitable. Again, whilst the Committee has devoted some attention to the question of taxation, it has failed to note how unfairly the present methods press upon the mineral industry, inasmuch as in levying income-tax no regard is given to the fact that a mine or a mineral property is necessarily a wasting asset, and that what is, in fact, to-day taxed as profit derived from the working of minerals is not all profit, but represents as to a portion of it a return of the capital invested. The only recommendation made on the very important matter of allowances for depreciation for income-tax purposes is that it should be "on an adequate scale"; the Committee does not appear to recognise that the principle of calculating depreciation upon the diminishing value of machinery and plant is wrong, and that the entire subject needs revision in the light of modern industrial methods.

As regards the supplies of ores, both of the ferrous and non-ferrous metals, the present report does not advance in any way upon the reports of the respective Departmental Committees, except in so far as they would receive much valuable assistance from the Imperial bureau of mineral resources. It need scarcely be said that the report contains a vast amount of valuable information, and will well repay attentive perusal; nevertheless, the special aspect of the whole subject, to which attention is here devoted—namely, the future development of the mineral resources of the Empire—has not received the share of consideration to which its pre-eminent importance entitles it. This was, perhaps, inevitable, having regard to the constitution of the Committee and the wide range of its inquiries; but it is none the less to be regretted.

H. LOUIS.

NOTES.

THE long list of honours announced on Monday, for war and other services, in celebration of the King's birthday, includes the names of the following workers in scientific fields:—*G.C.V.O.:* Sir Alfred Keogh. *K.C.M.G.:* Sir William Leishman, F.R.S. *K.C.S.I.:* Sir Thomas Holland, F.R.S. *C.I.E.:* Lt.-Col. E. A. R. Newman, Indian Medical Service, superintendent, Medical School, Dacca, Bengal; Mr. J. R. Henderson, superintendent, Government Museum; Mr. C. A. Barber, Agricultural Service, Imperial sugar-cane expert, Madras. *K.C.B.:* Surg.-Gen. H. D. Rolleston. *C.B.:* Sir Hugh Bell, Bart. *K.C.M.G.:* Prof. John Cadman. *C.M.G.:* Prof. H. L. Ferguson, professor of ophthamology, University of Otago. *Knights:* Mr. Harry Baldwin, for services as dental surgeon to his Majesty for a number of years, and as head of the Kennington Facial Hospital; Mr. C. H. Burge, late departmental principal of the Government Laboratory; Mr. Mayo Robson, past vice-president of the Royal College of Surgeons; and Dr. E. D. Ross, principal of the School of Oriental Studies.

THE British Science Guild is organising a comprehensive exhibition of products and appliances of scientific and industrial interest which prior to the war were obtained chiefly from enemy countries but are now produced in the United Kingdom. His Majesty the King has graciously consented to become patron of the exhibition, and the Marquess of Crewe, K.G., is president. Among the vice-presidents are the Prime Minister; Mr. Winston Churchill, Minister of Munitions; Sir Albert Stanley, President of the Board of Trade; Mr. H. A. L. Fisher, President of the Board of Education; Dr. Addison, Minister of Reconstruction; Lord Moulton; Lord Rayleigh; Lord Sydenham; Sir J. J. Thomson, president of the Royal Society; Sir Norman Lockyer, and Sir William Mather. The exhibition, which will be held at King's College from about the first week in August until the first week in September, will show, in the first place, products chiefly imported from Germany before the war, but now made in this country; and it will also illustrate the remarkable developments that have taken place generally in our scientific industries. In many of these, as a matter of fact, Great Britain always excelled, and it is only our national quality of self-depreciation which has prevented the public from appreciating the fact that we were able to export to Germany apparatus and products embodying the highest scientific knowledge and technical skill. The general scope of the exhibition has been set forth in a preliminary leaflet which has been issued, from which it is noted that the exhibits will include chemical products, thermal, electrical, and optical appliances, glass, quartz, and refractory material, photographic apparatus and material, surgical and medical appliances, and papers and textile products. It is believed that the exhibition will have a most stimulating influence upon scientific and industrial research, and the exhibits, with the demonstrations and lectures that will be given in order to explain them, will undoubtedly bring home to manufacturers, as well as to the general public, the great and growing part that science plays in industry. Further particulars may be obtained from the Organising Secretary, 82 Victoria Street, London, S.W.1.

THE KING AND QUEEN gave a small dinner-party at Buckingham Palace on Tuesday night, at which the guests included Sir Joseph Thomson, president of the Royal Society, and Lady Thomson, and Sir Frederic Kenyon, president of the British Academy, and Lady Kenyon.

The Geological Society of France has awarded this year's Gaudry medal to Prof. H. F. Osborn, of the American Museum of Natural History.

The family of the late Dr. George J. Hinde has presented to the Geological Department of the British Museum (Natural History) his collection of fossils, with numerous microscopic preparations illustrating his researches on radiolaria, sponges, and other small organisms. Most of the fossils were collected by Dr. Hinde himself from the Palæozoic formations of Canada, the United States, and Sweden.

The Wilbur Wright memorial lecture of the Aeronautical Society will be delivered in the Central Hall, Westminster, on Tuesday, June 25, at 8 o'clock, by Prof. W. F. Durand, chairman of the American Advisory Committee for Aeronautics, Scientific Attaché to the American Aviation Mission in Europe, and professor of mechanical engineering, Stanford University, U.S.A. The subject will be "Some Outstanding Problems in Aeronautics."

The second reading of the Coinage (Decimal System) Bill was moved by Lord Southwark in the House of Lords on Tuesday, June 4. Lord Leverhulme opposed the motion, though he was not against the principle of decimal coinage. He objected to making the sovereign the unit and dividing it into one thousand parts, and he thought that a British decimal system of coinage should be based upon the halfpenny. After discussion, the debate was adjourned on the understanding that the Government will institute an inquiry into the whole question of decimal coinage, including the proposals contained in Lord Southwark's Bill.

We learn from *Science* that Dr. Ferdinand Braun, who shared the Nobel prize in 1909 with Mr. Marconi for distinguished achievements in the invention of improved methods of wireless telegraphy, died on April 14 at a Brooklyn hospital. Dr. Braun was born in Fulda, Germany, in 1850, and was professor of physics in the University of Strassburg, when he went to the United States in 1914 as a witness in litigation between the Marconi Wireless Co. and the German company which built and operated the wireless station at Sayville, L. I.

A mysterious epidemic has made its appearance in Madrid, and is stated already to have claimed more than 100,000 victims. In offices, factories, and schools some 30 to 40 per cent. of the inmates have been attacked, and all classes of the community are affected. The disease commences suddenly with severe headache, followed by high fever, throat irritation, some bronchitis, muscular and joint pains, gastric disturbance, and depression and debility; these symptoms last for three to four days, and then convalescence commences. At first the disease was quite benign, but now is fatal to a certain proportion of debilitated subjects. According to a correspondent of the *Times*, there were more than 700 fatal cases in the ten days ending June 2. The disease in many respects resembles influenza, but the influenza bacillus has not been found. A meningococcus-like microbe, termed a para-meningococcus, has been isolated.

The Inter-Allied Scientific Food Commission, which has met in Paris and Rome, is now holding a meeting in London. The Commission consists of two scientific delegates from each of the four countries—America, England, France, and Italy—and one from Belgium. The object of the Commission is to consider all questions affecting the supply of food to the various Allied countries, in agreement with the Allied Food Executives (which determine the division of food among the Allies), and to make what recommendations it thinks advisable to the respective Governments. At the first two meetings certain physiological principles were established, such as the amount of food necessary for each man, and, as a result, the amount of food necessary for each country. The question with which the Commission is now concerned is the making of a census of the production of foodstuffs in each country. The members of the Commission will attend the meeting of the Royal Society to be held to-day, when it is hoped that as many fellows as possible will be present to meet them.

The Food Investigation Board of the Department of Scientific and Industrial Research has appointed a committee to inquire into the present methods of freezing, storing, and preserving fish, and to conduct experiments directed towards the improvement of existing methods. The constitution of the committee is as follows:—Mr. H. G. Maurice (chairman), Board of Agriculture and Fisheries; Prof. W. M. Bayliss, professor of physiology, University of London; Prof. J. Stanley Gardiner, professor of zoology, Cambridge; Mr. Crawford Heron, Swansea; Prof. F. Gowland Hopkins, professor of biochemistry, Cambridge; Mr. W. J. Howard, Ministry of Food; Mr. Douglas Johnstone, Ministry of Food; Staff Paymaster Jones, Fishery Board for Scotland; Prof. J. C. McLennan, professor of physics, University of Toronto; Prof. G. H. F. Nuttall, Quick professor biology, Cambridge; Sir Thomas Robinson, Grimsby; ex-Provost Malcolm Smith, Fishery Board for Scotland; Mr. J. M. Tabor, Peninsular House, E.C.3; Mr. H. J. Ward, Dartford Iron Works, Kent; and Mr. E. Warner, National Fish, Poultry, Game, and Rabbit Association, Leicester, with Capt. L. H. James as secretary. All communications intended for the committee should be addressed to the Secretary, Fish Preservation Committee, at 43 Parliament Street, London, S.W.1.

The sixteenth annual meeting of the South African Association for the Advancement of Science will be held in Johannesburg on July 8–13, under the presidency of Dr. C. F. Juritz. The presidents of the sectional committees will be as follows:—Section A, Astronomy, Mathematics, Physics, Meteorology, Geodesy, Surveying, Engineering, Architecture, and Irrigation: Prof. J. T. Morrison. Section B, Chemistry, Geology, Metallurgy, Mineralogy, and Geography: Dr. P. A. Wagner. Section C, Botany, Bacteriology, Agriculture, and Forestry: Mr. C. E. Legat. Section D, Zoology, Physiology, Hygiene, and Sanitary Science: Prof. E. J. Goddard. Section E, Anthropology, Ethnology, Native Education, Philology, and Native Sociology: Rev. W. A. Norton. Section F, Education, History, Mental Science, Political Economy, General Sociology, and Statistics: Prof. T. M. Forsyth.

As is well known, German dirigibles are equipped with wireless, but there has always been a certain amount of speculation as to how the scarcely perceptible signals can be heard in the midst of the noise due to the motors and the displacement of the air. According to a German technical publication (quoted in *La Nature*, May 25), a special method is in use. The high-frequency oscillations of the receiving station act on an Einthoven galvanometer. The plant recalls the prismatic sight. Underneath is a small electric lamp, the light of which falls on a narrow slit, ordinarily covered by the galvanometer string. The string is in an intense magnetic field. When the receiving current passes, the string deviates, thus allowing the luminous ray to be perceived. The observer at the sighting device can thus read the signals transmitted, in dots and dashes, in the form of short or long light-rays projected by the illuminated slit.

The Leeds automatic telephone exchange, which was opened on May 18, is the largest automatic exchange in Europe. Sir William Slingo, the head engineer of the Post Office, was one of the first to recognise that the manual operators in an exchange will ultimately have to be replaced by automatic devices. The longer the development is delayed, the more capital will be lost when the manual exchanges have to be scrapped. The Post Office has been criticised for carrying on the work in war-time, but the need was urgent, and, besides, the manual instruments displaced at Leeds were most useful for war service at the front. The Leeds exchange is equipped for 6800 subscribers, but it will ultimately have a capacity for 15,000. It represents the very latest developments in automatic working. A storage battery in the exchange supplies the energy required for the working of all the switches. The definite and accurate working of all the necessary switches when any subscriber takes his telephone off the hook and operates his dial is perfect. When the "called" subscriber is engaged the "busy back" signal is sent automatically, and the subscriber has to wait before he calls again. As there are 26,000 wires entering the building, the arrangement of all the connections is a marvel of ingenuity. The Post Office has several other automatic exchanges in this country. The next largest is at Portsmouth, which has 5000 subscribers already connected and an ultimate capacity of 7000.

In a recent letter to the *Times* (May 27) the Duke of Montrose pleads for moderation in the destruction of rooks. His lordship has examined thirty gizzards of birds shot between April 1 and May 31, twenty of which contained worms and grubs, six had grains of oats and other matter, one beetles and worms, and one horse-manure and grit. The fallacy, however, of judging of a bird's feeding habits by examining the food content of the stomach during certain periods of the year has frequently been dwelt upon, and just as in this case it would lead the uninitiated to pronounce a verdict in its favour, in regard to other species it would lead us to condemn undoubtedly beneficial species. Whilst not wishing to see the rook exterminated, experience shows that it certainly requires reducing in numbers. An investigation, now extending over four years, on the food of the rook, during which period upwards of 2000 birds have been examined, shows that of the total food eaten in a year, 35·1 per cent. consists of cereals, 13·4 of potatoes and roots, 6·1 of miscellaneous vegetable matter, 4·4 of weed seeds, 23·9 of injurious insects, 3·5 of beneficial insects, 4·6 of neutral insects, 3·2 of slugs and snails, 4·4 of earthworms, and 1·4 of eggs, mice, etc. In other words, 52 per cent. of the rook's food is injurious, 19·5 neutral, and 28·5 beneficial. It is, therefore, impossible to ignore the fact that at present this bird does considerably more harm than good, and that there is now overwhelming evidence to this effect which it would be foolish for the farmer to ignore.

Spring has closed with a burst of brilliantly fine weather, and May almost throughout maintained its usual characteristic of fickleness. The first half of the month was cooler and the rainfall was generally heavier than in the latter part of the month. At the commencement of May the cold was greatest in Scotland, the weekly weather report, ending May 4, showing the deficiency of temperature to be 4° F. in Scotland E.; at Greenwich the deficiency was only 1·4°. For the week ending May 11 the temperature was not very different from the normal in any part of the British Isles, and at Greenwich there was an excess of 1·6° F. For the week ending May 18 temperature had an excess of 5·3° at Greenwich, and for the week ending May 25 an excess of 6·2°. The highest temperature at Greenwich was 83° on May 21, whilst at Camden Square the thermometer registered 88°, and at Tulse Hill 87°. At the latter station the mean temperature for May was 58°, the mean maximum was 68°, and the mean minimum 48°. The mean maximum temperature for May 1 to 15 was 62°, and the mean maximum for May 16 to 31 74°, whilst the mean minimum was respectively 46° and 51°. Temperature this year in May is nearly as high as last year, and is about 4° above the normal. An absolute maximum of 83° has frequently been beaten for May at Greenwich, but there has been no record as high as 88°.

We have received from the Rev. S. Graham Brade-Birks descriptions of a curious cloud effect which he has observed over Darwen Moor, Lancashire, the point of observation being in the town of Darwen, to the east of the moor. The effect consisted of a thin stratum of cloud which appeared to run parallel to the contour of the hill of the moor for a considerable distance from south to north. The cloud was noticed on two separate occasions, viz. on May 6, at 9.30 p.m., and on May 17, at 10·15 p.m., summer time. On the first occasion the sky was otherwise cloudless; on the second the stratum of cloud was superimposed upon a background of cumulo-nimbus cloud, in the western sky, from which rain afterwards fell. On both occasions there was a light N.W. or W.N.W. wind at the surface at 10 p.m., summer time, which had succeeded a light or moderate S.S.E. wind at 10 a.m. The weather-maps for the two occasions present some points of similarity. On May 6 Darwen was situated in the col or "saddle" between two "highs" and two "lows"; on May 17 it was in the corner of a north-easterly extension of an anticyclone—that is, just on the high side of a "saddle." In such circumstances pilot-balloon observations have frequently revealed the existence of two distinct currents of air superimposed one upon the other, one current conforming with one of the barometric systems, and the other with the system on the opposite side of the place of observation. The sequence of wind observations at the surface would support such a view for these occasions. The bounding plane between the two currents would be a region where stratus clouds, due to mixing of moist air of different temperatures, would be liable to form. There may be some feature of the Darwen Moor which would locally facilitate such a process.

At the suggestion of the Palestine Exploration Fund, an organising committee has been constituted by the British Academy with the object of founding a British School of Archæology at Jerusalem. The committee, in a memorandum just issued, points out that while American, French, and German schools of archæology existed in Jerusalem before the war, this country possessed no such institution. It is proposed to establish a school to be devoted, both by excavation and surveying, to the furtherance of Palestinian archæology in all its branches. In addition to Hebrew and Jewish sites and antiquities, the school would include within its scope the Canaanite, Græco-Roman, Byzantine, Arab, and Medieval periods. An essential part of the scheme is that the school should be not only an excavating body, but also a training school for archæologists. It is hoped that universities, colleges, other institutions, and private patrons will provide a number of annual scholarships of 100*l*. each. The organising committee invites contributions towards an endowment fund, which has been started with gifts of 1000*l*. each from Mr. Walter Morrison and Mr. Robert Mond. It is hoped that a minimum of 20,000*l*. will be raised. Mr. Robert Mond will act as treasurer of the fund, and contributions should be made payable to him, crossed "a/c British School of Archæology at Jerusalem." All communications should be addressed to the honorary secretary, Prof. I. Gollancz, British Academy, Burlington House, Piccadilly, W.

EARLY in 1914 Mr. J. Reid Moir began to make a detailed study of two ancient levels formerly occupied by man, now buried in a brickfield near Ipswich. He has just completed the work, which is the most exhaustive research of the kind hitherto undertaken in this country, and the results are published in the last part of the Journal of the Royal Anthropological Institute (vol. xlvii.). With the aid of several specialists, whose reports are included, Mr. Moir deals with the subject from every point of view. The flint implements are illustrated in many beautiful drawings by Mr. E. T. Lingwood, those of the lower level being clearly late Mousterian, while those of the upper level are Aurignacian. Two specimens found in the hill-wash overlying the upper level are Solutrean, and an arrowhead from the surface soil is Neolithic. These implements were examined by the late Prof. V. Commont, who noted that they represented the same succession of types as he had discovered in the loams and alluvium of Northern France and Belgium. Some fragments of human bones found on the lower level are considered by Prof. Keith to be essentially identical with those of modern man. Some pieces of pottery from the same level are also interesting.

THIRTY-FIVE years ago a committee of the British Association compiled a table to represent the average heights and weights of British children at each year of growth. Experience has shown that the standards laid down by the committee are not satisfactory. In recent numbers of *School Hygiene* (December, 1917, April, 1918) Major James Kerr seeks to lay down what may be described as an ideal British standard. He assumes that the average Briton, if reared under healthy conditions, should reach the height of 1·770 m. (5 ft. 10 in.), some two inches above our present average. "By selection of the children to be measured, excluding the deformed and diseased, the backward mentally, and starved, ill-clothed, and city-dwarfed children, it should be possible to lay down standards for height considerably above the measurements at present considered satisfactory." Indeed, the standards laid down by Major Kerr are considerably above the measurements yielded by the best samples of British children. We believe that such an ideal standard will not prove satisfactory, because the admission or rejection of children considered healthy will depend on the individual judgment of the medical officer concerned. Nevertheless, Major Kerr's papers form a valuable contribution towards the solution of a difficult problem.

IN association with the article in our issue of May 16 on "The Co-ordination of Scientific Publication," it is of interest to note that at the Congress of Archæological Societies held in November last Mr. H. St. George Gray pointed out the desirability of more co-ordination in the exchange of archæological publications so as to secure for each society a full record of published work. The difficulty in completing sets of Proceedings arose generally from the fact that most societies had their scarce volumes due, amongst other causes, to the publication of important contributions of more than local interest, which led to an abnormal demand on the number of copies printed. As a result, odd volumes required to complete library sets had to be sought in second-hand book lists, as the cost of reprinting scarce issues was usually prohibitive. Special publications, volumes issued for members only, and loose-leaf publications were often omitted from exchanges, and in the absence of carefully compiled indices important contributions were often either overlooked or seriously delayed. Adequate index volumes are of especial value in archæological publications, and should be issued and exchanged by all societies concerned with the subject. An additional consideration arose from the fact that indices were often published as extra volumes, and were not included in exchanges. Although the value of exchanges between societies was regarded from the scientific rather than from the commercial point of view, any difficulties connected with special issues of this character should be capable of equitable adjustment by proportional payments.

LITTLE is yet known in regard to the reproductive organs of the Cetacea. A paper on this subject, which appears in the *Journal of Anatomy*, vol. iii., part 2, by Prof. Meek is therefore welcome. Prof. Meek deals with the modifications these organs present in relation to function rather than with their general disposition. Both sexes of the common porpoise (*Phocaena communis*) and the male organs of the white-beaked dolphin (*Lagenorhynchus albirostris*) are described at length, and some valuable notes on the male organs of other species of Delphinidæ and on the remarkable spermathecal recess of female Cetacea are also given.

THE March issue of the *American Museum Journal* (vol. xvii., No. 3) contains among several admirably illustrated articles one by Mr. D. B. Macmillan on "The Food Supply of the Smith Sound Eskimo." After surveying the abundant food supplies during the polar summer, Mr. Macmillan shows how the Eskimo, who is perforce entirely carnivorous, consumes about 1000 lb. of meat a year, about half of which is eaten raw and frozen. A high proportion of this generous diet is consumed during summer and autumn. Winter is often a period of want. Mr. Macmillan points out that probably already the war has affected the well-being of these far northern people. For many years they had depended on Danish trading ships not only for tobacco, matches, thread, needles, etc., but, more important, for firearms, knives, steel traps, and other implements of the chase. The non-arrival of the trading ship in 1917 forced the Eskimo largely to fall back on the hunting methods of a century ago—to bone arrows, ivory harpoon-shafts, flint knives, and so forth. Another year of these conditions, Mr. Macmillan believes, will result in so great a falling off in food supplies that the tribe will dwindle to a pitiful few.

M. LEROY described before the Société des Experts Chimistes de France recently a new process of examining eggs by photography. The opacity of the shell is got over by using intense illumination, a luminous objective, extra-sensitive plates, and other suitable devices. M. Leroy uses a graduated transparent scale, which is reproduced photographically at the same time as the egg. The method described has the advantage over the "shadow" method that it reproduces the internal condition of the egg. The eggs are tested in the way that steel rails, shells, etc., are—*i.e.* by selecting a certain percentage for test from each batch.

DR. L. DE LAUNAY, in the issue of *La Nature* for May 18, describes the efforts of a French company to cultivate the eucalyptus and pine on a large scale in the Peñarroya district of Spain (on the borders of Córdoba and Ciudad Real) for the production of paper-pulp. At first the geological conditions of this region were not considered favourable for intensive afforestation, but experiment showed that the two woods mentioned would yield satisfactory results under proper treatment. The results are justifying expectations, and it is hoped that the once barren region will in a few years repay the time and money spent in developing it. The wood will be used for pulping, pit-props (there are mines near), and for the distillation of acetic acid, etc.

FROM a copy we have received of Prof. Righi's paper on the ionisation produced by X-rays in a magnetic field, which appeared recently in the *Annales de Physique*, it is evident that the presence of a magnetic field has an influence on the process of ionisation of gas molecules not taken into account in previous descriptions of the process. If two horizontal plates are maintained at a difference of potential in a rarefied gas through which X-rays are passing, and the electric current between the plates is measured, we get the well-known relation between the current and the applied potential. If a horizontal magnetic field is superposed on the electric field between the plates, we should expect the deflection of the electrons produced by the field to diminish the current between the plates. This Righi finds to be the case for fields of 1000 gauss, but for fields of 300 or 400 gauss he finds the current is increased slightly by the presence of the field. He ascribes this effect to the electron placing itself so that its orbit is perpendicular to the field. The force of the field on it then being centrifugal, there is an increased tendency for ionisation to occur in the gas.

THE *British Journal of Photography* in its issue of May 5 directs attention to the numerous openings for improvements in optical apparatus as at present constructed, and advises manufacturers to employ experts to examine and improve their designs. As examples, it suggests the provision of two shallow saw-cuts at opposite ends of a diameter of each bezel ring used in a lens mount, so that by placing the edge of a steel rule in the cuts the ring can be easily removed. For lantern condensers the fine threaded screw method of mounting should be given up and replaced by the bayonet catch, or, better, by a stiff spring ring inside the mount holding the front lens against a loosely fitting separating ring, which in turn holds the back lens against a flange on the inside of the mount at the lantern end. Holes should be provided in the mount to allow any condensed moisture to get away. The condenser should be mounted in a cradle, which will allow of its insertion and removal when the lantern is in use without its being necessary to remove the lamp and withdraw the condenser through the body of the lantern, as is so often the case.

PROF. E. W. MARCHANT read an interesting paper on "Some Transient Phenomena in Electrical Supply Systems" to the Institution of Electrical Engineers on May 24. The experiments were made with the help of an oscillograph at the electrical station and substations of the Liverpool Corporation. Prof. Marchant investigated the "current-rushes" on switching transformers into the circuit. The results obtained bear out the conclusions which Prof. Fleming arrived at in the experiments he carried out twenty-five years ago at the Deptford power-station of the London Electric Supply Corporation, which was the first high-tension supply station in the world. Prof. Fleming's apparatus was, naturally, more primitive, but with the help of vacuum tubes and improvised electrical stethoscopes he detected all the main phenomena. We were specially interested in Prof. Marchant's oscillograms, showing the rush of current which ensues when an induction motor is switched into a circuit, as they prove that, although the initial rush of current may be the same whether the machines be carefully synchronised or not at the moment of switching in, yet the current diminishes to its steady value much more rapidly in the former case. The latter part of the paper on the current-surges which occur when putting alternators in parallel, and the transient currents which ensue on switching on and off high-tension cables, although containing little that is novel, gives excellent illustrations of the substantial accuracy of the ordinary differential equations used by engineers.

OUR ASTRONOMICAL COLUMN.

EARLY HISTORY OF THE SOLAR SYSTEM.—An important contribution to the mathematical investigation of the evolution of the solar system has been made by Dr. Harold Jeffreys in a communication to the Royal Astronomical Society (Monthly Notices, vol. lxxviii., p. 424). It is first shown to be improbable that the planets were formed by the gradual condensation of a gaseous mass, and it would seem that they were strongly condensed from the beginning, and were formed catastrophically. The tidal theory is therefore adopted, according to which a star of mass several times greater than that of the sun approached it so closely that the tidal action resulted in the extrusion of one or two streams of matter having a considerable velocity. These streams would break up almost at once into a series of fluid masses, and the gaseous matter set free in the initial disruption would form a resisting medium, the effect of which would be to reduce the eccentricities of the original orbits. From the rate of change of eccentricity it is provisionally estimated that the age of the solar system is 3×10^9 years, which is in general agreement with the age derived by radio-active methods. Among other results of interest it is shown that all the bodies having diameters less than 1000 km., if assumed to be composed of silica, must have been liquid or solid from the beginning, as smaller masses could not have been held together by their own gravitation when in the gaseous state. Dr. Jeffreys considers that the asteroids were probably formed from a primitive planet which approached Jupiter so closely as to be broken up by tidal action.

STELLAR INVESTIGATIONS AT MOUNT WILSON.—In the *Journal des Observateurs*, vol. ii., No. 6, Mr. W. S. Adams gives a brief account of the more general stellar investigations which have recently been carried on at Mount Wilson Observatory. Following an explanation of the spectroscopic method of determining stellar parallaxes, it is stated that the method has now been applied to more than a thousand stars, and that the precision of the results appears to be of the same order as that of parallaxes measured directly. In regard to stellar motions, space velocity appears to be mainly a function of absolute magnitude, the fainter stars moving more rapidly than the brighter, probably to some extent on account of difference in mass, the less massive stars having the greater velocities. A recomputation of the constants of the solar motion gives the position of the sun's apex as R.A. 270·9°, decl. +29·2°, and velocity 21·48 km. The investigations of stream motion furnish considerable support to the view that the stars show a motion of revolution around the centre of the galaxy, and that stream motion is mainly a local effect of this revolution. Studies of star clusters and of the comparative spectra of near and distant stars have indicated that the amount of absorption or scattering of light in space must be extremely small. The 60-in. reflector has been used to establish magnitude scales over a wide range, the faintest stars included being of photographic magnitude 20·1.

SPECTRA OF CHROMOSPHERE AND CORONA.—The results of measurements of a plate obtained at Vavau, Tonga Islands, during the total eclipse of the sun of April 28, 1911, have recently been given by the Rev. Father A. L. Cortie, S.J. (Monthly Notices, R.A.S., vol. lxxviii., p. 441). The photograph was taken with a prismatic camera under somewhat unfavourable conditions, but it extends far into the red, and twenty-five chromospheric lines not previously recorded have been found between λ 6600 and λ 7640. The majority of these are probably due to iron, but there is a fairly strong line at λ 6941, which remains unidentified. There are indications of a new coronal radiation about λ 7150, which is possibly related to the previously known line at λ 5535·8, in agreement with the theoretical investigations of Prof. Nicholson.

THE METRIC SYSTEM AND DECIMAL COINAGE.

NOTWITHSTANDING the growing demand in this country for our adoption of the metric system of weights and measures and a decimal system of coinage, the Committee on Commercial and Industrial Policy after the War has reported against the early introduction of both these overdue reforms. It is proposed in the following commentary upon the Committee's recently issued report (Cd. 9035, chaps. x. and xi.) to show that the arguments upon which these decisions are based are open to considerable criticism. For ease in reference these comments generally follow the sequence of the report.

The Metric System.

The Result of the Permissive Act of 1897.—In its historical review of the previous efforts to establish the metric system in this country, the Committee states that, although the use of the metric system has been permissive for the last twenty years, the number of metric weights and measures presented annually for verification and stamping is now only about 1 per cent. of the number of Imperial weights and measures similarly presented. The Committee has apparently failed to realise that the Act of 1897 alone could not possibly extend our use of the metric system, because, for example, it is obviously impracticable for tradespeople to have two different sets of weights—in different systems—in concurrent use on their shop-counters. It is also unreasonable to expect British manufacturers to employ the metric system in their workshops so long as our railways are permitted to refuse consignments of their products unless the Imperial equivalents of the weights and dimensions are also stated.

Further evidence of the futility of this Act as a measure for encouraging the use of the metric system in this country is unconsciously supplied by the Committee itself in its statement that even our present limited use "appears to arise mainly in connection with the recent legislation of metric carat weights and the adoption in the British Pharmacopœia of metric weights and measures for the prescription of doses." The 1897 Act has thus proved a dead letter, and further legislation is already long overdue.

As in the case of the daylight-saving scheme, the community as a whole cannot enjoy the benefits of the metric system until its use is established by law.

The Difficulty of Spare Parts and Renewals of Machinery.—The report states that, in order to enable the British machinery-maker to supply spare parts and renewals, it would be necessary for him to continue the Imperial system in use, side by side with the metric system, for possibly a generation after our official abandonment of the Imperial system, and that he would accordingly be required to work in two systems for that period.

This objection evidently arises from an unwarrantable assumption that our adoption of the metric system would necessarily involve altered dimensions of machine parts. Such is not the case, because obviously any dimensions now expressed in inches and parts thereof can be readily expressed in millimetres and parts thereof. It should be remembered that a tolerance of one-hundredth part of a millimetre demands much more accurate work than is usually obtainable in our machine-shops; so that those opponents of metric measures who claim that metric equivalents of Imperial dimensions can be shown only by employing six figures or so after the decimal point are obviously drawing on their imagination and appealing to the credulity of those whose support they seek.

British manufacturing engineers have for years worked in mils (0·001 in.), and the worst the metric system could demand of them, viz. 0·01 mm., would thus represent a saving of one figure in written dimensions. In practice, for small dimensions, two or more figures would generally be saved, because the dimension 0·1 mm. (roughly four mils, or 0·004 in.) would be quite fine enough for most of their work. Equivalents expressed even so approximately as the nearest whole millimetre—thus dispensing entirely with the decimal point—could not differ from the original Imperial dimension by more than one-fiftieth part of an inch.

Furthermore, the passage of an Act requiring all sales to be made in terms of the metric system would not affect the liberty of any person to continue his use of the existing weights and measures for manufacturing purposes until such time as he himself chose to abandon them. All existing patterns could thus be employed for the full term of their useful lives, and when in the normal course they became worn out or obsolete in design they could be economically replaced by new ones based on the metric system.

Manufacturers engaging in new industries should, at the outset, base their designs on the metric system, and it is gratifying to note that this has been done, for example, in the case of the British magneto industry, which has been so successfully established in this country since the outbreak of the war.

The Value of a Universal Language of Quantity.—Regarding the point raised by the Committee that if we now adopted the metric system we should be required to work in two systems for a generation, it may be remarked that, even were this true, it would be much less appalling than our alternative prospect of employing two systems for all time. The fact remains that, whether we like it or not, we already find ourselves obliged to use the metric system to an ever-increasing extent in scientific work, in manufacture, and in export trade; and the retention of our own Imperial system thus handicaps us by compelling us to employ two systems where one would suffice.

When we realise that our national existence depends upon our ability to sell British manufactured goods to all nations, *i.e.* to develop a world-wide trade, it is obvious that Great Britain—more than any other country—would benefit from the establishment of a universal system of weights and measures.

The use of the metric system is already obligatory in thirty-four countries, representing a population of 437 millions, and optional in a further eleven countries having a population of more than 727 millions. By ourselves adopting it we should practically ensure its establishment as the universal language of quantity, but, on the other hand, it is equally clear that the Imperial system could never become the universal system because of its inherent defects.

The Influence upon our Export Trade.—In opposing the proposal that legislation should be introduced whereby all *sales* would be required to be expressed in metric terms, the Committee states that "the continuance of manufacture on the existing system while the sale of the product had to be made on the metric system would be confusing and inconvenient."

This admission illustrates the indifference of the Committee to the "confusion and inconvenience" which it evidently considers British exporters should continue to suffer, because it is precisely under these conditions that we are attempting to expand our overseas trade. After the war it will be just as necessary for Great Britain to organise and develop her export trade—in order to reduce the burden of taxation and restore her financial stability—as it has been for her to organise the manufacture of munitions during the war, and yet the Committee cannot agree to assist our exporters by removing this unnecessary "confusion and inconvenience."

Are we for ever to remain deaf to the advice of our overseas commercial representatives—both Government and private—who for years past have urged us to adopt the metric system? The opinions of these "men on the spot" are apparently quite ignored, as no reference is made to them in the report.

This brings me to the Committee's remarkable statement that, as more than half the volume of our pre-war export trade was with non-metric countries, we should stand to lose more than we could gain if we adopted the metric system. Realising apparently how unsubstantial this argument is, the Committee proceeds to qualify it by saying:—"The position would no doubt be materially altered *if*" the Colonies and other outstanding countries "would simultaneously with us adopt the metric system." It is curious that, in regard to the Colonies, any doubt of their readiness to follow our lead should be entertained, especially as in the same report the Committee states:—"At the Colonial Conference of 1902 a resolution in favour of the introduction of the metric system throughout the British Empire was carried." This desire was confirmed by the Dominions Royal Commission Report of 1917, which stated, in regard to the metric system:—"There is clearly in the Dominions a considerable body of opinion in favour of the change. So far, however, all efforts to induce the community in the Mother Country to agree to a change have proved unavailing."

According to statistics quoted by the Committee in another part of the report (chap. ii.), rather more than one-third of the annual value of the exports of the produce and manufactures of the United Kingdom went to British Possessions during the fourteen years ending 1913, and the item coal represented "fully three-quarters of the total weight of our exports of all kinds."

Obviously, coal could be exported just as readily in metric tons as in Imperial tons, so that if the Committee had boldly stated that Great Britain's adoption of the metric system would certainly be followed promptly by similar action on the part of the Colonies and British Possessions, and probably by America at no very distant date, they could have presented a strong case in favour of the metric system instead of a weak case against it.

In concluding that the United States would be opposed to the metric system, the Committee has apparently failed to appreciate that it was anti-metric only so long as its products were principally destined for home consumption or for export to the British Empire. But note what is happening now that the United States aspires to become an exporting nation in the widest sense. In the last few years the American demand for the metric system has grown enormously, and in his report, dated January, 1916, to the International High Commission relative to the use of the metric system in export trade, Dr. S. W. Stratton (Director of the Bureau of Standards at Washington) said:—"Any manufacturer who, through ignorance, fear of confusion, or lack of enterprise, is unwilling to attempt to meet the requirements of foreign trade should confine his attention to our domestic trade. He should not, however, be permitted to retard the development of foreign trade by his inertia or indifference to the metric system, which is now the legal system in thirty-four of the countries whose trade we seek. Still less should his opposition or his opinion have consideration in comparison with the judgment of those who seek earnestly and by all possible means the extension of trade with metric countries."

Note also the significance of the official announcement published in January, 1918, to the effect that the United States War Department had adopted the metric system for the artillery, machine-guns, and maps required by their armies in the present war. Whether Great Britain or the United States takes the lead in the complete adoption of the metric system, it is reasonably certain that the other would quickly follow, and, in view of our greater dependence on overseas trade, it is clear that we ought to move first.

The Effect upon our Competition with Germany.—The statement that our adoption of the metric system would place us at a disadvantage with Germany should be contrasted with the attitude of the German nation, which, in the early 'seventies, adopted what was known as the French system, notwithstanding the anti-French sentiments then existing on account of the Franco-Prussian War. Since that time twenty-four other countries have likewise adopted what is now truly described as the *international* metric system, and we accordingly remain a non-metric country to our own serious disadvantage. The war has demonstrated the need for greater intimacy of contact between the man of science in his laboratory and the industrialist in his workshop. In Germany the metric system is common to both these partners in progress, but in this country, while the metric system is the language of science, it is a comparatively unknown tongue in our workshops. Is it to our advantage that this estrangement should be perpetuated? If we adopted the metric system at once we should surmount the temporary difficulty of accustoming ourselves to the metric notation long before Germany emerged from under the cloud of the world's disapproval consequent upon her infamous acts in the present war. We cannot, however, rely upon this sentiment lasting more than a few years, so we should act promptly. All our industries will require overhauling when we abandon the manufacture of war munitions in favour of peace products, and it is wrong to assume that we shall simply revert to pre-war standards. New methods, new designs, new ideas will be the order of the day, and the time will be particularly opportune for starting afresh on the metric basis.

The Opposition of the Textile Trade.—Evidence of the antagonism of the textile trade appears in several parts of the report. This attitude suggests the thought that even assuming the textile industry feels so sure of its grip on the world's markets that it can afford to dispense with the benefits of the metric system and to ignore the convenience of its overseas consumers, that is no adequate reason in itself why all the other industries of the nation should be deprived of the support they would derive from Great Britain's adoption of the metric system. It may be recalled that the watch industry of Switzerland similarly held out against the Swiss adoption of the metric system, and that it was accommodated by being specially exempt from the compulsory provisions of the Metric System Act. But what was the sequel? A very few years' experience proved to the Swiss watchmakers that they had denied themselves advantages which their fellow-countrymen enjoyed, and they then accordingly voluntarily fell into line. It is to be hoped the British textile industry will note and profit by this example.

In the meantime, it is well also to bear in mind the facts recorded by the Committee in chap. ii. that "of the yarns exported in 1913, about one-third was taken by Germany" (already a metric country), and that "rather more than half of the total exports of piece-goods went to British Possessions," which, as mentioned above, only await the lead of the Mother Country to justify their adoption of the metric system.

The Educational Aspect.—The Committee's attempt to discount the advantages of the metric system in educational matters is very weak, and may be usefully contrasted with the authoritative statements published in the recently issued "Report of the Committee Appointed by the Prime Minister to Inquire into the Position of Natural Science in the Educational System of Great Britain" (Cd. 9011). One of this Committee's summarised conclusions reads:—"That the present chaos of English weights and measures causes waste of time and confusion of thought, and that there are strong educational reasons for the adoption of the metric system."

The "Improvement" of the Imperial System.—Realising that although it cannot recommend the metric system it also cannot establish the superiority of our existing system, the Committee adopts the expedient of advocating the so-called "improvement" of the Imperial system. To that end the members "emphasise the advantages, already widely recognised, of using decimal subdivisions of our basic units, such as the inch and the pound weight." This leaning to decimalisation is especially noteworthy in view of the contradictory opinion expressed elsewhere in the report that "for practical purposes binary divisions are better than decimal."

In this connection it is instructive to recall the recommendations of the Select Committee of the House of Commons which so long ago as 1862 reported that "it would involve as much difficulty to create a special decimal system of our own as simply to adopt the metric system in common with other nations, and if we did so create a national system we would in all likelihood have to change it again in a few years as the commerce and intercourse between nations increased into an international one." That was fifty-six years ago. Further comment is superfluous. If, instead of decimalising English units, we could agree forthwith to express all weights and dimensions in terms of single units (*e.g.* pounds, yards, and gallons), abolishing all the chaotic multiples of 12, 3, 5½, 40, 8, etc., the way would be paved for our early adoption of the metric system.

Decimal Coinage.

The report reviews the various proposals which have been made from time to time, and concludes that our ultimate choice must rest between (*a*) the retention of the £ sterling as the monetary unit and its division into 1000 parts, or (*b*) the creation of a new monetary unit equal to 100 halfpence—viz., a gold dollar of 4*s.* 2*d.*

After recording its opinion as being strongly in favour of the first of these alternatives, the Committee enlarges upon the difficulties incidental to the decimalisation of the £ sterling, and concludes, by a majority (not unanimously), that the change would be inexpedient at the present time or in the immediate future.

The above-mentioned difficulties fall chiefly under two heads, viz.:—(1) The necessary alteration of the value of the penny. (2) The use of three figures after the decimal point.

Of the former it may be said at once that it is high time the penny coinage was changed, because of its failure to meet fluctuations in currency values and gradual changes in the prices of small articles and services.

By way of illustrating the failure of the penny to meet present-day needs, it will have been noted that while the cost of many daily necessaries may have been increased by (say) 20 per cent., it has been necessary to raise the price of halfpenny goods and services by 100 per cent. to one penny, and of penny ones by 50 per cent. to 1½*d.*, because of our lack of coins to represent intermediate values. The case of the penny stamp is a recent example. This unsuitably steep grading of the present coinage has proved a source of hardship, especially to the poorer classes, who are obliged to purchase food and other daily requirements in "pennyworths."

The provision in the new Bill of an enlarged range of low-value coins should greatly facilitate the change from pence to mils. As, for example, neither the 4-mil nor the 5-mil coin would be exactly equal to the present penny, it is thought better to include both coins than arbitrarily to say that the new penny shall be either 4 per cent. less or 20 per cent. more than the present penny. In course of time any coins which experience had shown to be superfluous could be withdrawn from circulation.

The equivalent in mils of any sum now stated in pence would be ascertained by adding one-twenty-fourth part to the number of farthings contained therein, from which it will be seen that each complete sixpence would have its exact equivalent in twenty-five mils. On this basis all new coins could be issued to the public in exact exchange for existing coins, thus avoiding loss to either the individual or the State.

In order to meet the second difficulty, which is more apparent than real, of employing three figures after the decimal point, it is suggested that the present three-column method of cash entry might be retained. The existing cash columns, rechristened £ *f. m.* instead of £ *s. d.*, would conveniently separate the pounds from the florins and the florins from the mils, and *no decimal point would be required.* Instead of learning "12 pence in a shilling and 20 shillings in a pound," school children would be taught "100 mils in a florin and 10 florins in a pound." Under this arrangement prices lower than a £ would be quoted in florins and mils just as we now employ shillings and pence.

In its criticism of a draft Bill (submitted by the Institute of Bankers) the Committee makes the erroneous statement that this has been adopted also by the Association of Chambers of Commerce and the Decimal Association. What really happened was this: After the bankers' draft Bill had been submitted to the Committee, conferences took place between the three above-mentioned organisations, and a new Bill (based upon the bankers' draft but containing important modifications and improvements) was mutually adopted by the unanimous agreement of all the parties.

Attempts were made to lay these new proposals before Lord Balfour's Committee, but a reply was received to the effect that the Committee had by that time ceased to take evidence, and nothing could be done. This is particularly to be regretted, because the improved Bill meets many of the difficulties mentioned in the Committee's report.

The new Bill has just been before the House of Lords, and consideration of it has been postponed on the understanding that the Government will institute an inquiry into the whole question. The Bill received widespread and influential backing, having been introduced by the Association of Chambers of Commerce of the United Kingdom (representing more than 130 Chambers throughout the country), and supported by the Decimal Association and many organisations representative, among others, of:—*Finance*, the Institute of Bankers; *Commerce*, Chambers of Commerce; *Industry*, Federation of British Industries; *Science*, British Science Guild; *Transport*, Municipal Tramways Association; and many professions and trades. This unanimity of organised opinion augurs well for the eventual adoption of a reform which, as hinted at by the Committee, has possibly suffered more hitherto from the diversity of advice tendered by its advocates than from any real opposition either in or out of Parliament.

HARRY ALLCOCK.

PROGRESS OF THE EDUCATION BILL.

DESPITE the pressure of other urgent measures and the consequent limitations as to time, and in spite also of the persistent opposition of certain Members, good progress is being made with the Education Bill in the House of Commons. Already clause 10, the crucial clause of the measure, which is to secure the continued education of young persons from fourteen to eighteen years of age who have entered into employment, has been reached. It is to be hoped that the endeavour of Mr. Fisher to preserve the contact of adolescent youth with the humaner side of life during these formative years, whilst giving effect to all reasonable opportunities for enhancing both knowledge and aptitude in the chosen vocation, may receive complete support and be assured of legal enactment.

It is in this connection satisfactory to find that the great evil of half-time, which has mainly characterised the textile industrial areas of the country, has found little support in the House, and clause 8, section 1, abolishing all exemptions up to the completion of the fourteenth year of age (to come into operation on the close of the war), has been passed without a division. We thus secure that the child in the elementary school will now have at least a complete preliminary course of education and training from the beginning of his sixth to the completion of his fourteenth year, and the nation comes into line with the more advanced industrial and commercial nations of the Continent who are its greatest rivals.

Moreover, liberty to raise the school age until the completion of the fifteenth year of age, with or without exemptions, at the option of the local education authority has secured the assent of the Committee by a very large majority, and it is further provided that adequate provision shall be made in order to secure that children and young persons shall not be debarred from receiving the benefits of any form of education by which they are capable of profiting through inability to pay fees. In view of the necessity of encouraging the development of higher education in county areas, it is satisfactory to find that there was unanimous assent to the abolition of the limit of expenditure from the rate by county council committees.

Provision is made for the due inspection of private schools with a view to the elimination of unsatisfactory establishments by bringing them under the direct supervision of the local authorities and of the Board of Education. A step has also been taken at the option of the local education authority to raise the compulsory age of entrance to the elementary school from five to six years, provided that adequate provision is made in the area for the establishment of duly equipped nursery schools. It is a pleasant thing to note that in the establishment by scheme of joint committees teachers are expressly named as eligible for co-optation. The efforts of the friends of this important measure should now be firmly concentrated upon the provisions of clause 10, so as to secure that the proposals of Mr. Fisher, who has so far piloted the Bill with such admirable tact, shall be given legislative effect. Whatever be the merits of the Hibbert amendment, and they are by no means absent, they are not comparable with the advantages to be gained by the intimate association of young persons with the beneficial influence of the schools up to the conclusion of their eighteenth year.

ORGANISATION OF GLASS INDUSTRIES.

THE Society of Glass Technology held an important meeting at the Institute of Chemistry on May 15, when the president, Mr. Frank Wood, in opening a discussion on "The Glass Industry after the War," advocated the formation of trade councils for the organisation of the various sections. He proposed that a federation should be formed, controlled by a council consisting of sectional representatives, both manufacturers and men, together with representatives of science, the Government, and finance. The matter should be taken in hand immediately, and every effort made to secure workmen and machinery to enable the country to supply all its requirements, instead of about 20 per cent. in pre-war days. To do this, Government assistance is necessary. Without protection in some sections and prohibition in others, there would be a deluge of foreign glass just when their furnaces and shops ought to be undergoing repair and when time would be required for the training of workers. They should be ready for the future, and the Optical Munitions and Glassware Supply Department of the Ministry of Munitions, to which they were so much indebted, should continue in being to help them. Mr. Connolly voiced the need for a dump-proof Empire in order that a fair chance might be given to home production. Sir Frank Heath dealt with the necessity for bringing science to bear on the matter, assuring the meeting of the desire of the Government to assist research through industrial organisations. The conditions under which grants are made are not onerous, and the researches are conducted free from meticulous interference from headquarters. Mr. Douglas Baird referred to the production of chemical ware, which will not be able to stand on its feet for some time without the aid of "foster-parents." Sir Herbert Jackson spoke hopefully of the general outlook. National prestige must supply the stimulus for pulling together after the war. Their representatives should be brought into collaboration with Government representatives to deal with the problems before them. Mr. Biram, of the Ministry of Munitions, acknowledged the great help of the manufacturers in the production of war material; the future would call for all their energy and enterprise. Dr. Rosenhain appealed for the fullest utilisation of scientific results and the interchange of knowledge and experience. Mr. S. N. Jenkinson said that the industry must make itself efficient if it is to be supported by the Government. Many other members joined in the discussion, and it was agreed that a resolution on the policy of the society should be circularised among the members for consideration before the next meeting, which is to be held in Sheffield on June 19. Before the meeting the members enjoyed a visit to Messrs. Ediswan, Ltd., at Ponders End.

THE ROYAL OBSERVATORY, GREENWICH.

THE report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, was read at the annual visitation of the Observatory on Saturday, June 1. The subjoined extracts are from the report.

Greenwich Catalogue.

Advantage is being taken of the delay in the printing of the Greenwich catalogue of 12,000 stars for 1910 to insert the type of spectrum as well as the magnitude of the star on the Harvard scale. This has been made possible by the kindness of Prof. Pickering, who is supplying, partly in manuscript and partly in early proofs, the results of Miss Cannon's survey at Harvard College. Discussions of some points connected with the proper motions of the stars in this catalogue have been communicated to the Royal Astronomical Society, and others are in progress.

Heliographic Observations.

In the year ended May 10, 1918, photographs of the sun were obtained on 209 days. The transmission to England of the solar photographs taken at the Royal Observatory, Cape of Good Hope, has been suspended for the present, the last originals received being those for February, 1917, and the last duplicates those for the month previous. Similarly, no application has been yet made for photographs taken at the Indian observatories of Kodaikanal and Dehra Dûn to fill up gaps in the combined Greenwich-Cape record. The days in 1917 left without representation in the combined record are only nine in number, and for eight of these days photographs taken at Kodaikanal are available; the only date in 1917 still without a photograph being March 12.

H.M. Astronomer at the Cape has reported that the sun was successfully photographed there on 333 days in the year 1917, and on every day in January, 1918. The director of the Kodaikanal Observatory has reported that the regular series of photographs of the sun was recommenced there on April 1, 1917, and that plates were taken on 248 days out of the 275 of the nine remaining months of the year.

During the whole of the period covered by this report the spot-activity has been considerable, but it reached a remarkable development during August, 1917, the mean daily spotted area during the second week of that month being the highest as yet registered in the Greenwich photographic record. No disturbance comparable with this has occurred since, but considerable secondary maxima, with total spotted areas of more than 1000 millionths of the sun's visible hemisphere, were observed in September and December, 1917, and in February and March, 1918.

Magnetic Observations.

The mean values of the magnetic elements for 1917 and three previous years are as follows:—

	Dec. W.	Hor. force	Vert. force	Dip
	° ′			° ′
1914 ...	15 6·3	0·18518	0·43317	66 51·2
1915 ...	14 56·5	0·18508	0·43315	51·8
1916 ...	46·9	0·18494	0·43313	52·7
1917 ...	37·0	0·18477	0·43305	53·6

The annual diminution of declination increased considerably about 1910, its average value from 1900 to 1910 being 4·9′. The horizontal force, which had been increasing since measurements were begun at Greenwich in 1846, reached a maximum about 1910, and is now diminishing. The dip, which has been diminishing since measurements were begun in 1843, reached a minimum about 1913, and is now increasing.

There were no days of great magnetic disturbance in 1917, but four were classified as of lesser disturbance. Traces of the photographic curves for these days will be published in the annual volume.

Meteorological Observations.

The following details of the weather refer to the year ended April 30, 1918. The mean temperature was 50·0°, or 0·4° above the average of the seventy-five years, 1841–1915. The highest temperature in the shade was 93·2° on June 17, and the temperature exceeded 80° on fifteen days. The lowest temperature was 17·2° on December 19, and on fifty-three days fell as low as 32·0°.

The mean daily horizontal movement of the air was 298 miles, which is fourteen miles above the average of the previous fifty years. The greatest daily movement, 767 miles, was recorded on November 24, and the least, forty-seven miles, on December 20. The greatest recorded pressure on the square foot was 18·8 lb., on October 25; the greatest velocity in one hour, forty-six miles, was registered on the same day.

The duration of bright sunshine registered by the Campbell-Stokes instrument was 1668 hours out of a possible 4456 hours, or 36·1 per cent. January provided more and April less than any corresponding month since the present instrument was set up in 1897.

The rainfall was 28·06 in., or 3·82 in. above the average for the period 1841–1915. The number of rainy days (0·005 in. or over) was 156. March, with 0·97 in., was the driest, and August, with 4·56 in., the wettest month.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BY the will of Dr. E. A. Letts, professor of chemistry in Queen's University, Belfast, who died in February last, his collection of minerals is bequeathed to Queen's University, and, on the death of his wife, 2100*l*. for the endowment of a scholarship in the University.

MR. JOHN OWENS, of Chester, has been authorised by certain friends to offer the University of Wales on their behalf 10,000*l*. war stock towards the establishment of a music directorship on the lines indicated in the report of the Royal Commission on University Education in Wales.

THE Education Bill and eugenics is the subject of an article by Mr. Wm. C. Marshall in the *Eugenics Review* for April (vol. x., No. 1). Mr. Marshall believes that the Bill bids fair, if loyally carried out, to satisfy the requirements of the intelligent artisan, and to assure him that he can in the future count on obtaining for any of his children, inheriting his qualities and reared under his care and supervision, an education which will assure their position in the industrial world. On these grounds the conclusion is that the Bill should be cordially welcomed by eugenists.

INTERESTING and instructive statistics concerning the growth of secondary education in England and Wales are contained in the Report of the Board of Education for the year 1916–17 (Cd. 9045). The total number of secondary schools in England regarded by the

Board of Education as eligible for grant during 1916–17 was 931, and in them there were 198,759 pupils, of whom 103,819 were boys, as compared with 189,487 pupils, of whom 99,205 were boys in the same number of schools during 1915–16. In addition to the 931 schools on the grant list, the Board recognised 125 other schools as efficient, and in these schools, during 1914–15, 25,033 pupils were being educated. Though the numbers for 1916–17 are not available, the report says it is probable that the number of pupils in these efficient schools increased, on the whole, in about the same proportion as in the schools on the grant list. The Board of Education has found that the withdrawal from the schools of the younger and more vigorous masters, and their replacement by others of lower physique, of more advanced years, and often of inferior qualification, is an educational loss for which there can be no effective compensation. The effect of increased entry and enforced stoppage of building has been to cause serious overcrowding, which, unfortunately, must for the present be regarded as inevitable.

IN his presidential address to the Society of British Gas Industries, Sir Robert Hadfield devoted one section to a consideration of the world's facilities for higher education. According to his investigations, there are about 280 universities in the world, with some 500 "special colleges" and 100 technical schools, staffed by about 53,000 trained teachers and investigators. Excluding India, the white population of the British Empire is about 65 millions, served by 48 universities, which gives one university for each $1\frac{1}{4}$ millions of population. In Great Britain and Ireland, with a population of some 45 millions, there are 18 universities, which works out at one university for each $2\frac{1}{2}$ millions of population. In Canada, Australasia, and South Africa, where the population is distributed over very much larger areas, the proportion is naturally higher, and is about one university for each two-thirds of a million population. In France and Italy the proportion is just about the same as in Great Britain and Ireland. As regards Germany, if the technical high schools of university rank are grouped with the universities, the proportion is one per two millions of the inhabitants. In Austria-Hungary the proportion is about one per $4\frac{1}{2}$ millions, and in Russia it is only one per 14 millions of population. The country which contains the largest number of universities, both absolutely and in proportion to population, is the United States of America, where one university exists for each million of inhabitants. Sir Robert Hadfield gives an interesting table showing the chief subjects dealt with in universities and technical schools, and the number of universities at which each subject is taught.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 16.—Sir J. J. Thomson, president, in the chair.—A. **Mallock**: Note on certain coloured interference bands and the colours of tempered steel. After alluding to the interference bands seen when two rows of posts, etc., or two gratings, are viewed one through the other, the paper deals with a particular case of such bands, namely, that when a plate of dispersive material, such as glass, is placed between the two gratings, or, which amounts to the same thing, when a single grating is placed on a thick mirror, and the interference takes place between the grating and its reflective image. The bands so formed are coloured. The composition of the colours in terms of primary red, green, and violet is given diagrammatically by means of Maxwell's chromatic triangle for nine examples. It is noticed that the sequence of colours in some of these agrees closely with those of tempered steel. It is shown that the colours of tempered steel are not "colours of thin plates," and it is suggested that they must be due to the formation of some material the molecular period of which is comparable with the period of light-waves, and not to a structure comparable with the wave-length.—J. C. M. **Garnett**: General factors in mental measurements. An inquiry into the mathematical argument for the existence of Prof. Spearman's general factor g, in all mental abilities of which measurements had been published during many years, led to an investigation into the consequences that must follow from the condition that the correlation between every pair of columns in a correlation table is ± 1. These consequences were found to be that there is one, and only one, factor common to all the qualities the correlations of which form the table; that there are no group factors common to two or more qualities but not to all; and that there may be any number of specific factors each belonging to one quality only. It was found that any quality which is distributed according to the normal law, and depends only on n independent factors (qualities), say $x_1 x_2 \ldots x_n$, which are distributed according to the normal law and have the same standard deviation, may be represented by

$$q = l_1 x_1 + l_2 x_2 + \ldots + l_n x_n$$

where

$$l_1^2 + l_2^2 + \ldots l_n^2 = 1.$$

The standard deviation of q, moreover, will be the same as of $x_1 x_2 \ldots x_n$. The existence is indicated of a third general factor c ("cleverness") independent both of Prof. Spearman's g ("general ability") and of Dr. Webb's w ("purpose"). How much would be known concerning the mental qualities of an individual whose g, w, and c had been measured is discussed in concluding the paper.—C. M. **Williams**: The absorption of X-rays in copper and aluminium. The paper deals with the relation between the mass absorption coefficients of X-rays in copper and aluminium and the respective wave-lengths over a range of 0·431–0·637 A.U. The relation between the two absorption coefficients are examined and the dependence of each of the latter on the wave-length. A notable feature is the occurrence of discontinuities in the curves representing the results; these may probably be connected with the J-series recently described by Barkla. With respect to the approximate relation between the mass absorption coefficient μ/ρ and the wave-length λ given by the equation $\mu/\rho = a\lambda^n + C$, where a, n, and C are constants, it appears that, while the relation is fairly well satisfied in the case of copper by giving n the value 5/2—a result in conformity with Owen's 5th-power absorption law—the results for aluminium show a value $n=3$.—Dr. T. R. **Merton**: The electrical resolution and broadening of helium lines. (1) The broadening of helium lines by condensed spark discharges is in close agreement with the electrical resolution of the lines. (2) The "isolated components" in the electrical resolution which have been recorded by Brunetti, and by Takamine and Yoshida, have been found in the broadened lines. (3) An explanation is offered of the relative degree of broadening of lines of the "arc" and "spark" type, on the supposition that the latter act as a kind of safety valve to the former when the intensity of excitation becomes very great. (4) It is suggested that the "isolated components" are not a direct product of the electrical resolution, but are in reality an extension of the helium spectrum. Two of these lines may, perhaps, be represented as lines of combination series.

Paris.

Academy of Sciences, May 21.—M. Léon Guignard in the chair.—P. **Termier**: Contribution to the knowledge of the tectonic of the Asturias.—C. **de la Vallée Poussin**: The best approximation of the functions of a real variable by expressions of given order.—E. **Ariès**: The saturated vapour pressures of tetratomic bodies. The method described in earlier papers is applied to the cases of ammonia, acetylene, and phosphorus trichloride. From the experimental data available a full comparison is only possible in the case of ammonia, and for this the agreement between the experimental and calculated values is very satisfactory.—J. **Pérès**: Some remarks on certain developments in series.—A. **Buhl**: The series of Taylorian polynominals and Weierstrass domains.—M. **Luizet**: Observations of the brightness of Nova Licorne.—A. **Véronnet**: The cooling and evolution of the sun.—C. **Matignon**: Ferro-silicons not attacked by acids. Analyses are given of six ferro-silicons and one ferro-boron and the loss on treatment with four acid solutions, two of nitric acid and two of mixtures of acetic and butyric acids, studied. The comparative losses under similar conditions are tabulated.—MM. **Masson** and **Faucon**: The absorption of ultra-violet radiations by the phenylmethanes. Details of measurements are given for benzene, toluene, diphenylmethane, and triphenylmethane.—Ed. **Chauvenet** and Mlle. L. **Nicole**: The basic nitrates of zirconyl.—D. **Berthelot** and R. **Trannoy**: The sugar content of *Sorghum saccharatum* at different stages of growth. The results of analyses of juice taken on eight dates between August 10 and November 30 show a maximum sugar content about October 5. It is shown that the richness in sugar can be calculated from the density of the juice.—L. **Cavel**: The antiseptic value of some essential oils. The experiments were carried out on diluted sewage, and the amounts of essential oil determined stopping all bacterial growth. Results are given for forty-five essences, phenol being used as a standard of comparison. Two-thirds of the essential oil examined proved to be stronger antiseptics than phenol, oil of thyme being the most powerful.—M. **Folley**: The aorta in exophthalmic goitre.

BOOKS RECEIVED.

The British Academy. Cosmic Law in Ancient Thought. By T. W. Rhys-Davids. Pp. 11. (London: H. Milford.) 1s. net.

Italian Mountain Geology. By C. S. DuRiche Preller. 2 parts. Part i., pp. 99; part ii., pp. 107 to 192. (London: Dulau and Co., Ltd.)

The Art of Health. By J. Long. Pp. xi+192. (London: Chapman and Hall, Ltd.) 5s. net.

An Introduction to the History of Science. By Prof. W. Libby. Pp. x+288. (London: G. G. Harrap and Co., Ltd.) 5s. net.

Acoustics for Musicians. By Prof. P. C. Buck. Pp. 152. (Oxford: Clarendon Press.) 7s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, June 6.

Royal Society, at 4.30.—Brevity, Frequence of Rhythm and Amount of Reflex Nervous Discharge as Indicated by Reflex Contraction: N. B. Dreyer and Prof. C. S. Sherrington.

Royal Institution, at 3.—The Abode of Snow; Its Appearance, Inhabitants, and History: Sir F. Younghusband.

Linnean Society, at 4.30.—A Revision of Some Critical Species of Echium [Viper's Bugloss], as Exemplified in the Linnean and other Herbaria, with a Description of *Echium judaicum*, a New Species from Palestine: C. C. Lacaita.—Experiments with Cyclamen: Capt. A. W. Hill.—The Relationship between the Symbionts in a Lichen: R. Paulson and S. Hastings.—Abnormal Apple-blossoms and Fruit: W. C. Worsdell.

FRIDAY, June 7.

Royal Institution, at 5.30.—The Romance of Petroleum: Sir B. Redwood.

SATURDAY, June 8.

Royal Institution, at 3.—Problems in Bird-migration: Prof. C. J. Patten.

MONDAY, June 10.

Aristotelian Society, at 8.—The Ontological Argument for the Existence of God: Prof. A. A. Cock.

Royal Geographical Society, at 8.—The Backbone of Africa: Sir Alfred Sharpe.

Society of Engineers, at 5.30.—War on and under the Sea: Edwin Hall.

TUESDAY, June 11.

Zoological Society, at 5.30.—On Two New Elasmobranch Fishes from the Upper Jurassic Lithographic Stone of Bavaria: Dr. A. Smith Woodward.—The Function of Pathology in Evolution: Morley Roberts.

WEDNESDAY, June 12.

British Association Geophysical Committee (Royal Astronomical Society), at 5.—*Discussion:* The Tides. Opener, Prof. H. Lamb, followed by Prof. Love, Mr. Proudman, and others.

THURSDAY, June 13.

Optical Society, at 7.—The Prevention of Filming in Enclosed Optical Instruments: H. S. Ryland.—A Chart for Finding the Number of Lenses in, and Size of, a Block: Horace Lee.—Charts for Assisting in the Selection of Suitable Glasses for Cemented Doublets: T. Smith.

FRIDAY, June 14.

Royal Astronomical Society, at 5.

Physical Society, at 5.—*Discussion:* The Teaching of Physics in Schools: Opener, Sir Oliver J. Lodge.

CONTENTS.

PAGE

Editorial and Publishing Offices:
MACMILLAN AND CO., Ltd.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: Phusis, London.
Telephone Number: Gerrard 8830.

THURSDAY, JUNE 13, 1918.

ALUMINIUM AND RARE EARTH METALS.

A Text-book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. Vol. iv., *Aluminium and its Congeners, including the Rare Earth Metals.* By H. F. V. Little. Pp. xx+485. (London: Charles Griffin and Co., Ltd., 1917.) Price 15*s*. net.

THIS book, the fourth of the series of nine volumes which constitute the "Text-book of Inorganic Chemistry," edited by Dr. J. Newton Friend, deals with the members of the third group of the Periodic Table. The arrangement of the subject-matter of the treatise in accordance with Mendeléeff's scheme has, no doubt, much to recommend it. The classification, of course, rests upon a rational basis, very different in character from the arbitrary and often inconsistent methods which prevailed prior to the enunciation of the epoch-making generalisation of the distinguished Russian chemist. At the same time, it must be admitted that the arrangement brings together elements which, at first sight, seem to have little or nothing in common. We jump, as it were, from boron to aluminium, from aluminium over scandium and gallium to indium, and thence by way of the "rare earth" metals to thallium. The older systems at least had the merit of attempting to group the elements so as to bring out their natural affinities as manifested by their chemical and physical attributes, and we seemed to pass from the consideration of one element to that of the next by easy and more or less obvious stages rather than by the brusque and *staccato* method of violent contrasts which appears to follow from the application of the periodic law.

Mr. Little, indeed, would appear to have been conscious of the somewhat bizarre effect which a too rigid adherence to the scheme of the table would produce in the arrangement of his material, and to some extent he meets the difficulty by starting with boron as the so-called "typical element," and following on with aluminium as a "short period" member. But it is really only in this sense and in its "formal valency resemblance" that boron can be styled a "congener" of aluminium. The other members of the group are "long period" elements, and are divided into the *odd* subgroup comprising gallium, indium, and thallium, and the *even* subgroup which comprises the "rare earth" metals but leads up to actinium, the relations of which to its "congeners" are as yet very ill-defined. Debierne regarded actinium as allied to thorium, which would place it in the next main group, but such congenital affinities as it possesses point to its being more akin to the cerium group, and thus afford some slight ground for placing it in the position assigned to it by the author.

In a short introductory chapter Mr. Little frankly faces the difficulties which his arrangement involves, and which grow upon him when he deals with the "rare earths," and in a few paragraphs refers to the analogies and discordances to which it leads. The student, therefore, is warned, at the outset, of its limitations—limitations necessarily imposed by the imperfect and provisional nature of the generalisation on which it is based, and of which the weakness is plainly revealed in the case of the "rare earth" elements.

With regard to the main body of the book we have little but praise. It has evidently been most carefully and conscientiously compiled, and practically every statement has been verified by reference to the original sources of information. The bibliography, indeed, is one of the most valuable features of the work, and will be appreciated, not only by the student, but also by the investigator, who may have to concern himself with the literature relating to the various elements and their compounds dealt with in the book.

The chemical history of boron has been brought up to the date of publication, but since the issue of the work much additional information has been gained respecting the many unstable hydrides of boron—a particularly difficult class of substances to deal with, but which have been investigated with great skill by Stock and his collaborators. The industrial extraction of boric acid and the manufacture of borax scarcely receive the treatment which they deserve as being by far the most important of the boron compounds. Incidentally, the writer terms the jets of steam from the volcanic vents in Tuscany *suffioni* instead of *soffioni*.

A good description of the methods of manufacture of metallic aluminium is given, together with a short account of its alloys, many of which are of growing importance. Compounds of aluminium, including some of the more important aluminous minerals, are dealt with in fewer than forty pages. The treatment is necessarily very slight in many cases, especially when compared with that of the chapter on clay and ceramics, which extends to more than thirty pages. This, and also the chapter on ultramarine, which seems to have been largely based on the article on that subject in Thorpe's "Dictionary of Applied Chemistry," are, judged by their length, the most important contributions to industrial chemistry in the book, which is otherwise not remarkable for its technology.

The most valuable feature of the work is, however, its treatment of the chemistry of the "rare earths." This section occupies more than half the volume, and is without doubt the fullest and most comprehensive account of their history, modes of extraction, properties, and relations which has yet appeared.

Although the first "rare earth" was discovered by the Finnish chemist, Gadolin, so far back as 1794, and was quickly followed by the isolation of other members of the group by Ekeberg, Berzelius, Gahn, Mosander, Cleve, Höglund, and others during the next fifty or sixty years, it is only within comparatively recent time that the chemistry of these substances has received its main development. This is largely due to the great extension of the gas-mantle industry, which, in its exploitation of the sources of thorium and cerium, has placed at the disposal of investigators relatively large quantities of material more or less rich in "rare earths." Indeed, in the case of certain of these substances the term "rare earths" is a misnomer. Some of them have been found to be widely distributed and to occur in large amounts. Accordingly, the literature on these elements has been largely augmented during the last few decades, as its bibliography shows, and it has needed no inconsiderable skill on the part of Mr. Little to deal with it within the limitations of space necessarily imposed upon him. The bibliography reveals how very slight and comparatively unimportant have been the contributions of German chemists to this literature. Up to the present there are some fifteen "rare earth" elements (excluding actinium) the identity of which may be considered as established, and all of these have been discovered by Scandinavian, Swiss, or French chemists. An Austrian chemist, Auer von Welsbach, resolved Mosander's didymia into its components, and he shares with Urbain the credit of proving that Marignac's ytterbia was complex. Investigators of the type of Klaproth, Bunsen, and Wöhler are, apparently, no longer to be found in Germany. The work of enlarging our knowledge of a particularly interesting group of elements of great theoretical importance and rich in possibilities of technical application is rapidly passing into the hands of Anglo-Saxon chemists, and especially of American chemists, who have not only devised adequate methods of separation and isolation, but have also incidentally contributed a great amount towards the chemical history of the individual metals.

We can unreservedly congratulate Mr. Little on the production of a particularly useful work. If the remaining volumes of the series maintain the same high level, the entire treatise will constitute a most valuable contribution to our chemical literature.

THE CONSTRUCTION OF HARBOURS.

A Treatise on the Principles and Practice of Harbour Engineering. By Dr. Brysson Cunningham. Second edition. Pp. xvi+377. (London: Charles Griffin and Co., Ltd., 1918.) Price 25*s*. net.

THE second edition of this standard work has been revised and brought up to date; much new matter has been added—including numerous additional illustrations—nearly a further hundred pages. Many of the points briefly referred to in the first edition have been elaborated, so that its pages are now crowded with useful information.

Chap. v., dealing with "Piling," is one of the most instructive in the book. Timber *versus* reinforced-concrete piles is discussed, also the various methods of pile-driving. The sustaining power of piles, and the prevention of destruction of piles caused by decay or by marine organisms, are ably dealt with. The Hennebique and other forms of steel sheet-piling are described and compared with timber sheet-piling.

The introductory chapter deals, among other matters, with the national interest in harbours, which will doubtless be more marked after the war than it was previously, for undoubtedly the State will take over many of our principal harbours, and in many cases enlarge them. Chap. ii., dealing with "Harbour Design," has been dealt with in a most exhaustive manner, and the author has done well to include particulars and illustrations of that harbour which has probably caused more discussion than any other—the Madras Harbour, the projection of which has resulted in such a huge accumulation of sand on the windward side (due to the south-west monsoon), necessitating the spending of large sums annually in dredging inside the harbour; while the havoc wrought by erosion on the lee side, due to the trapping of the sand by the harbour, is most serious. The effect of rivers flowing through harbours has had due consideration in the book, but the cause of bars occurring at the mouths of harbours, and the suggested means for removing these, have not been dealt with so fully as one would have wished.

The chapters on "Breakwater Design" and "Breakwater Construction" deal very fully with these subjects, and many excellent details of construction are given which would only occur to a practical author; the additional plates which have been added to these chapters increase their value immensely. Figs. 154–59, showing the constructional staging at Gibraltar Harbour Works, are admirable.

One is disappointed to find no reference made to slipway construction at a time like the present, when so many slipways are being laid down; and the notes on the action of sea water on concrete might have been extended. A few more examples of failures in breakwaters, either through faulty foundations or storms, would have added to the value of the book, for, after all, the engineer learns more from failures than from successes.

The use of reinforced-concrete in harbour engineering has not been given the prominence in the book that one would have desired, especially its use in the construction of jetties. The effect upon reinforced-concrete piles of their being alternately submerged in sea water in tidal work and exposed to air does not appear to be referred to, and this is at the present time a very debatable subject. The mechanical handling of material might have occupied more space in the book, and the use of reinforced-concrete in the building of lightships and in the construction of lighthouses might have been discussed.

The chapter dealing with "Surveying, Marine and Submarine," will be most useful to civil engineering students, the course of procedure being clearly set out and well illustrated, and the notes on this subject are very practical.

The chapter on "Channel Demarcation" is interesting, as it deals with lighthouses, lightships, and buoys, while that on "Pier-heads, Quays, and

Landing-stages" contains some excellent notes and illustrations of the more modern methods of construction of these structures. River quays and wharves are well described, and the Liverpool floating landing-stage is discussed and well illustrated.

The various tables in the book will prove of great value to the maritime engineer, especially those indicating (on pp. 66 and 67) the tidal rises at certain harbours. The specification for cement and concrete (on pp. 149–59) is also most useful, and some of the larger plates give a great deal of detail as to the planning of harbours. Fig. 36*a*, which is a plan of the Aberdeen Harbour, is exceptionally good. The illustrations generally are excellent; it is seldom that one meets with a technical work so well illustrated.

The second edition of this standard work should certainly find a place on the shelves of the library of every maritime engineer; as a book of reference it is second to none. E. R. M.

RADIO-THERAPY.

Radiography and Radio-therapeutics. By Dr. R. Knox. Second edition. Part ii., *Radio-therapeutics.* Pp. x + 387–606. (London: A. and C. Black, Ltd., 1918.) Price 15*s.* net.

THE second edition of Dr. Knox's work, "Radiography and Radio-therapeutics," is completed by the appearance of part ii., "Radio-therapeutics." Part ii. leaves on the mind of the reader very much the same general impression as that of part i., namely, that of an excellent production. A perusal of the book shows an ever-widening range of utility of X-rays and radium in the treatment and alleviation of disease. They are agents which, under expert guidance, are beneficial in the treatment, not only of superficial ailments such as intractable skin diseases, but also of deep-seated conditions; and of these the treatment of internal growths, benign and malignant, claims much of the author's attention.

Apart from the above-mentioned applications there is evidently a place for the radiations in the treatment of the several varieties of blood diseases and other somewhat obscure pathological conditions.

A special chapter is devoted to the use of X-rays and radium in injuries and diseases among the wounded, and a following chapter, which illustrates the value of radiations in plastic surgery of the face and jaws, is contributed by Mr. Percival P. Cole. The fearful nature of some of these wounds would lead many to despair of betterment, but the combination of surgery and the administration of some form of radiation have in many cases resulted in a veritable transformation of the patient.

The physical properties of the rays from radium and its emanation therefrom are very clearly dealt with in a chapter contributed by Mr. C. E. S. Phillips.

The thorough way in which the application of these agents to the appropriate pathological condition is set forth in this volume is in itself a reassurance as to their utility; but what pleases us most is the general outlook upon the subject of radio-therapeutics adopted by the author. A confidence in the utility of the agents he handles is tempered by a realisation of (1) the lack of precision in their administration, and (2) the little that is known as to the real nature of the changes set up in cell life under exposure to the rays. Moreover, he shows a keen appreciation of the service which the investigator may render to the future development of the subject of medical radiology, for on p. 395 we find: "By a combined attack from the physical and clinical aspects, we may hope in the near future to produce a marked improvement in our methods of treatment by radiations, which should result in material benefit to patients suffering from malignant disease."

The range of X-radiation which is at hand for clinical application covers several octaves, and the fact that one variety of cells may respond in a totally different manner from another, according to what type of radiation it is exposed to, is clearly in the author's mind when he writes, as on p. 540: "The reason why one case responds and another fails to do so is one of the profound problems which the radio-therapist is striving to fathom, and when the solution is arrived at it will go a long way to establish radiation treatment on a sound basis. In all probability the explanation is a biological one, a condition of cell, physical or other, which responds to a particular type of ray. . . ."

The book will undoubtedly do much towards a fuller recognition of the clinical utility of these radiations, and also towards placing radio-therapy on a surer scientific footing than it holds at the present day.

OUR BOOKSHELF.

Field Sanitation. By C. G. Moor and E. A. Cooper, in collaboration with other Officers and Men of the 1st London Sanitary Company. Pp. viii + 220. (London: Baillière, Tindall, and Cox, 1918.) Price 2*s.* 6*d.* net.

When the history of the war comes to be reviewed and all the marvellous achievements of our Army, none will be more noteworthy than the wonderful health record. This is, to a great extent, due to the work of the Sanitary Companies, and the volume under review, written by two of their officers, is intended to hand on the results of their experiences and those of their colleagues. It is written in simple and readable form, and will make a very useful text-book, not only for the highly trained but perhaps less experienced sanitary officers, but also for the men under their command.

The opening chapter deals with general hygiene, and includes notes on many, if not all, of the infectious diseases liable to attack the troops. Chapters follow on flies and other insect pests; disposal of refuse; latrine and urinal construction; baths and laundries; brickwork, wooden buildings, and metal work; disinfection; drainage and sewage disposal; water; ventilation; food; camping; economy; and the work of sanitary sections.

In the chapter on water much attention is devoted to the important question of sterilisation, and although the authors give a brief historical sketch of the subject of chlorine sterilisation, they fail to mention the pioneer work of Houston, who, so far back as 1905, was the first to apply the treatment to the whole water supply of a town when he undertook the sterilisation of the water supply of Lincoln, and who now controls the chlorination of a large part of the London water supply. The question of dose in relation to period of contact of the water with the sterilising agent seems to require some modification.

The authors show great ingenuity in finding a use for all sorts of waste materials, such as empty oil-drums, biscuit-boxes, and petrol-cans; in fact, it appears that the complete sanitary officer must not only be highly skilled in medical and sanitary science, but also have some considerable knowledge of such trades as bricklaying, carpentry, metal work, and a host of others, besides knowing something of allotment gardening and poultry farming.

The book is well illustrated with clear and well-drawn diagrams, and concludes with what appears to be a most complete and useful index.

D. B. B.

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.*]

Propagation of Sound and Light in an Irregular Atmosphere.

I SUPPOSE that most of those who have listened to (single-engined) aeroplanes in flight must have noticed the highly uneven character of the sound, even at moderate distances. It would seem that the changes are to be attributed to atmospheric irregularities affecting the propagation rather than to variable emission. This may require confirmation; but, in any case, a comparison of what is to be expected in the analogous propagation of light and sound has a certain interest.

One point of difference should first be noticed. The velocity of propagation of sound through air varies indeed with temperature, but is independent of pressure (or density), while that of light depends upon pressure as well as upon temperature. In the atmosphere there is a variation of pressure with elevation, but this is scarcely material for our present purpose. And the kind of irregular local variations which can easily occur in temperature are excluded in respect of pressure by the mechanical conditions, at least in the absence of strong winds, not here regarded. The question is thus reduced to refractions consequent upon temperature variations.

The velocity of sound is as the square root of the absolute temperature. Accordingly for 1° C. difference of temperature the refractivity $(\mu-1)$ is 0·00183. In the case of light the corresponding value of $(\mu-1)$ is $0{\cdot}000294 \times 0{\cdot}00366$, the pressure being atmospheric. The effect of temperature upon sound is thus about 2000 times greater than upon light. If we suppose the system of temperature differences to be altered in this proportion, the course of *rays* of light and of sound will be the same.

When we consider mirage, and the twinkling of stars, and of terrestrial lights at no very great distances, we recognise how heterogeneous the atmosphere must often be for the propagation of sound, and we need no longer be surprised at the variations of intensity with which uniformly emitted sounds are received at moderate distances from their source.

It is true, of course, that the question is not exhausted by a consideration of rays, and that we must remember the immense disproportion of wave-lengths, greatly affecting all phenomena of diffraction. A twinkling star, as seen with the naked eye, may disappear momentarily, which means that then little or no light from it falls upon the eye. When a telescope is employed the twinkling is very much reduced, showing that the effects are entirely different at points so near together as the parts of an object-glass. In the case of sound, such sensitiveness to position is not to be expected, and the reproduction of similar phenomena would require the linear scale of the atmospheric irregularities to be very much enlarged.

June 7. RAYLEIGH.

The Drift of Meteor Trails.

IN the Astronomical Column of NATURE of May 23 there appears a note on the currents in the upper air as revealed by the direction of drift of the streaks left by meteors. Before we can say with certainty, however, that such drift represents movement of the air, we require to know the real nature of a meteor trail. The ordinary view seems to be that the trail is composed of air heated by the meteor in its flight through the atmosphere, the heating being produced not so much by friction as by the compression of the air in front of the meteor. But is it physically possible for a mass of air so heated to retain its heat so as to remain luminous for any length of time? Streaks have been seen which remained luminous for more than two hours, and though this is exceptional, yet any explanation which would account for long-enduring trails would apply also to the more transient kinds. Is it not possible that the trail is an electrical phenomenon akin to an auroral streamer, or to the patches of light seen during an aurora? The movement of both trails and streamers is usually towards the east, but both more rarely move in other directions. The movement in the case of the aurora is presumably due to the passage of electrified particles moving in the earth's magnetic field, and deflected by it. Is it possible that a meteor trail is due to the passage of electricity through rarefied air that may have been ionised by the passage of the meteor?

It is difficult to imagine that there are definite air currents in the upper part of the atmosphere. It is true that balloons have not explored the atmosphere much above twenty miles, and that meteor trails are far higher. But it is difficult to suppose that conditions are other than isothermal, in a vertical direction, above the base of the stratosphere, however high one may go. If this is so, there would be no vertical circulation; and if there is no vertical circulation, could there be any horizontal circulation? There is usually a marked falling-off of the wind as a balloon enters the stratosphere. Perhaps some of your readers more versed in dynamical meteorology, and in the question of the passage of electricity through rarefied air than I am, can throw light on the problem.

June 4. C. J. P. CAVE.

THE NEW STAR IN AQUILA.

THE unremitting character of the watch kept on the sky by the amateur astronomers in this country is well shown by the number of independent discoveries of the new star. Apparently, the first observation was made by Miss Grace Cook at Stowmarket when on the watch for meteors at 9.h. 30m. G.M.T. on June 8. Other independent discoveries were made by Mr. W. F. Denning, at Bristol, and Mr. David Packer, at Birmingham, at 10.0 G.M.T.; Mr. C. L. Brook, at Meltham, at 10.15 G.M.T.; Mr. W. H. Steavenson, at West Norwood, at 10.30 G.M.T.; Mr. H. Thomson, at Newcastle, at 10.44 G. M. T., and Mr. Felix de Roy, at Thornton Heath, at 10.45 G. M. T. It was also noticed at 9.40 G. M. T. by Mr. Witchell, of the Royal Observatory, Greenwich, but not identified as a Nova. On the following day it was also detected independently in Scotland by Dr. Anderson, the discoverer of Nova Persei and Nova Aurigæ. Mr. Denning says that the increase in the light of the star must have occurred during daytime in England on June 8, for he was observing meteors nearly the whole of the preceding night and saw nothing unusual in the sky. Presumably, therefore, the object must have been faint at the time and, in any case, of such small magnitude as to enable it to escape detection. As yet little information has been received with regard to observations in other countries; the star was seen at the Hector Observatory in New Zealand, but apparently 12h. after its discovery in England.

At discovery the star was very nearly of the same brightness as Altair (0·9m.). The testimony of all the discoverers agrees on this point. It was confirmed by photometric observations at Greenwich by Mr. Jonckheere, who determined the magnitude with a wedge photometer by comparison with Vega, Arcturus, and Altair. The change of brightness in the short night of June 8 was very slight, if indeed perceptible. In colour the star was like α Aquilæ. With the highest power the star showed a sharply-defined stellar nucleus in the 28-inch telescope at Greenwich. So far as could be seen with an eye-piece prism, the spectrum appeared to be perfectly continuous, no night lines being detected. At the Cape Observatory the important observation has been made that the Nova contains hydrogen and calcium absorption lines similar to Nova Persei, February 22, 1901. It is not stated in the cablegram whether the observation was made on June 8 or June 9.

A great increase of brightness occurred in the next twenty-four hours. On Sunday night the star certainly equalled Vega (0·1m.) in brightness, though Vega was at a much greater altitude. Observation at Greenwich was somewhat difficult owing to some faint, low-lying haze. To some observers the star appeared to be considerably brighter than Vega. As on the previous night no bright lines were seen in the star's spectrum.

The position of the star relative to B.D. $+0°4023$ (8·5m.) was determined by M. Jonckheere. Using the position of this star given in the Abbadia Catalogue (1900) the position of the Nova is found to be

R.A. 18h. 44m. 43·48s., Dec. 0° 29′ 28·2″ for 1918·0

Direct observation at the Transit-Circle by Mr. Witchell gave

R.A. 18h. 44m. 43·47s., Dec. 0° 29′ 31·5″ for 1918·0

It was noticed by M. Jonckheere that a star on the Algiers Chart Zone +1°, No. 141, having the co-ordinates −3′ and −32′ and of the ninth magnitude seemed to be in the position of the Nova. Reference to the measures of the Algiers Astrographic Catalogue shows that this star is No. 108 on plate 1003. Its magnitude is given as 8·8m. Its co-ordinates on this plate (centre: 18h. 40m. and 0°) are +57·0074′ and +27·8588′. With the data given in the catalogue the position of the star is found to be

R.A. 18h. 44m. 43·52s., Dec. 0° 29′ 31·0″ for 1918·0

It thus seems very probable that the Nova is identical with this star of the Algiers Astrographic Chart and Catalogue, photographed on the dates Aug. 20, 1909 and June 26, 1895. This star is also shown on a Franklin Adams plate taken at Johannesburg in 1910. It cannot be said with certainty that these three photographs show no evidence of variability, though on the photographs of 1909 and 1910 the star is perceptibly fainter than the neighbouring star (No. 105 in the Algiers Catalogue) while in the catalogue (date of photograph, 1895) it is given as of the same magnitude (8·8m.). If the identity of the Nova with this star is confirmed the point is one of great interest.

It is fortunate that the Nova will be well placed for observation for some months, so that ample records of its varying luminosity and spectrum will probably be secured. At the present time the star rises practically due East at about 7.20 p.m., and is on the meridian, 39° above the horizon at London, at about 1.20 a.m., G.M.T.

F. W. DYSON.

The spectrum of the Nova was observed by me on June 10 with a McClean star spectroscope on a 3-inch refractor, and on June 11 with a Zöllner spectroscope on the 6-inch refractor at the Imperial College. It was not notably different on the two evenings, except that the continuous background was possibly more intense on June 10. In each case the spectrum strongly recalled those of Nova Aurigæ and Nova Persei in their early stages, shortly after maximum brightness. The most striking feature of the spectrum was the red line of hydrogen, which was of extraordinary brilliancy. In the green there was a group of four bright lines, of which the most refrangible and brightest was doubtless H_β, while the others may well have been the enhanced lines of iron about wave-lengths 517, 502, and 492, which were observed in previous novæ. Another conspicuous line in the blue was probably H_γ. There was also a broad nebulous line about λ 532, and another of the same character which was roughly estimated to be about λ 560. On the red side of the latter was a dark shading, and there was a strong absorption line or band which was estimated to be in the position of sodium D. There was possibly a bright fringe on the red side of this absorption line. Between D and C there were two fairly conspicuous bright lines, which were estimated to be in the neighbourhood of λ 615 and λ 630. The star was brighter than Altair, and was of a reddish-yellow colour.

A. FOWLER.

INSECT BEHAVIOUR.[1]

IT was on a *Harmas* (an untilled, pebbly bit of land) in Provence that Fabre, after heroic struggles, opened his "laboratory of living entomology," where, undisturbed, he might "pry into life." "Never, in my insect-hunting memories, have I seen so large a population at a single spot; all the occupations have made it their rallying-point. Here come hunters of every kind of game, builders in clay, weavers of cotton goods, collectors of pieces cut from a leaf or the petals of a flower, architects in pasteboard, plasterers mixing mortar, carpenters boring wood, miners digging underground galleries, artificers handling goldbeaters' skin, and many more." What a place for studying those inborn capacities for effective behaviour which we label instinctive! What disclosures this inimitable observer gives us—the sounds of the midsummer night from the tinkling of toads to the death-wail of the surprised cicada, the green grasshopper's strange banquet off her fertilising capsule, the quick and fatal bite which the "devilkin" or Empusa gives on the back of the butterfly's neck; the beautifully finished cupolas made by Eumenes wasps out of minute pebbles and mortar, and stored with half-paralysed caterpillars, the food for the grub which hatches out of the egg cleverly suspended from the roof; the way the glow-worm deals with snails, first chloroforming them and then drinking them, for the flesh has to be liquefied into a broth before it can be used. Fabre's words suggest that the liquid passes up the hollow mandibles to the mouth, but there seems some doubt on this point, as may be seen by comparing the recent observations of Miss Kathleen Haddon with those of Prof. Bugnion.

Apart from the sheer delight afforded by Fabre's intimate descriptions, the chief value of the essays before us lies in their evidence of the limitations of instinct, which gives a basis for the conviction, from which the author never departed, that instinctive behaviour is not in the same category as intelligent behaviour. On one hand we see extraordinarily perfect instinctive behaviour like that of the Capricorn grub boring in the depths of the oak-tree for three years on end, yet coming at the appropriate time to the surface and preparing down to minute details an exit for the future beetle. It behaves as if it had perfect prescience. On the other hand, the burying beetles, though persisting in trying all their bag of tricks when their undertaking is difficult, will allow themselves to be baffled by a hitch which the least spice of intelligence would remove, and will submit to incarceration in a prison which to expert tunnellers like Necrophori has practically an open door. Similarly, Fabre's procession caterpillars persisted for a week in a futile circumambulation of the margin of a vase in the garden. Instinctive

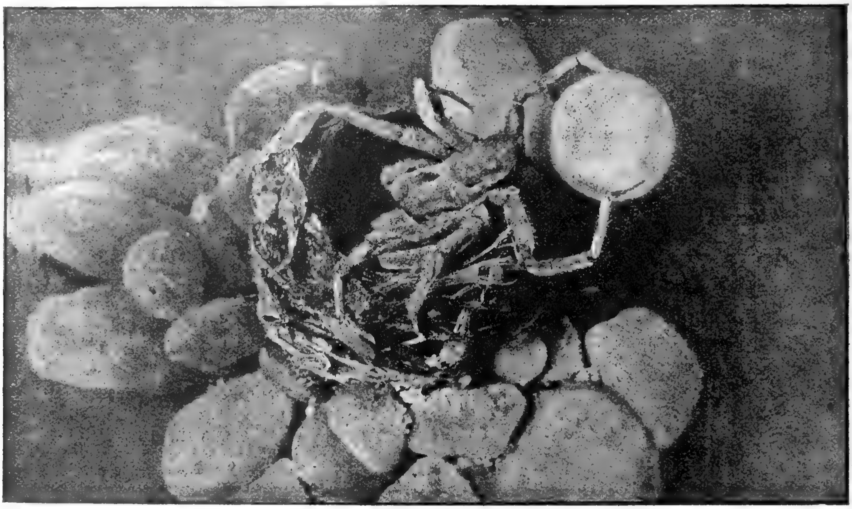


FIG. 1.—The Lycosa lying head downwards on the edge of her pit, holding in her hind legs her white bag of eggs, and lifting them toward the sun, to assist the hatching. From "The Wonders of Instinct."

[1] "The Wonders of Instinct. Chapters in the Psychology of Insects." By J. H. Fabre. Translated by A. T. de Mattos and Bernard Miall. Pp. 320. (London: T. Fisher Unwin, Ltd., 1918.) Price 10s. 6d. net.

behaviour depends on inborn, ready-made capacity; it is not reflective. But why did Fabre think that "transformism" was compelled to rank instinct in a line with reason?

Fabre was a very great naturalist, but not, of course, invariably wise. Thus, once in a way it may have been useful to deplore the fact, or supposed fact, that "natural history, youth's glorious study, has, by dint of cellular improvements [*sic*], become a hateful and repulsive thing," but it was unwise to reiterate contempt for the labours of the analytic zoologist who follows the nerve-fibres of a Cirripede, or counts the joints of a Crustacean's antenna, or puzzles over the architecture of an Annelid's egg. Fabre had no sympathy with this sort of study, and he did not understand it. The same must be said in regard to the great naturalist's attitude to "transformism" or evolution-theory.

The translation continues to be clear and spirited, but the right word has not always been found. More care should have been taken with the little notes; thus the word "species" is misused with tiresome reiteration; not every Annelid is a red-blooded worm; it is unhappy to say that "zoophytes are plant-like sea-animals, including star-fishes, jelly-fishes, sea-anemones, and sponges"; and surely the cicada is not "akin to the grasshopper." But these and their like do not affect the general success of the translators' work. We do not think that the British public could find reading much more wholesome than these essays by one of the greatest of observers, but we are in its name obliged to express to the publishers our surprise that this fascinating volume should contain several essays which we have read in book form before. We read "The Harmas" and "The Bluebottle" in "The Life of the Fly"; we read "The Processionary Caterpillar" and "The Cabbage Caterpillar" in "The Life of the Caterpillar." But can we have too much of a good thing?

PROF. P. BLASERNA.

OF the life and work of Prof. Pietro Blaserna, who died at Rome on February 26, an interesting account is now contributed by Prof. Cantone to the *Atti dei Lincei*, xxvii., (1) 7. Prof. Blaserna was born on February 29, 1836, at Aquileja, near Gorizia, and attended school at the latter place, afterwards proceeding to Vienna, where, after he had completed his degree course, he assisted in the physical department. Being thus a native of the scene of recent conflicts between Italy and Austria, he was entirely Italian in his sympathies, and, after studying in Paris under Regnault, he obtained a chair of physics, first at Palermo, and then at Rome. Here he devoted his main efforts to teaching and organisation, and succeeded in building up a school of physicists of which Italy has every reason to be proud. Instead of giving most of his time to researches, which might have necessitated his maintaining an attitude of exclusiveness towards elementary students, Prof. Blaserna endeavoured to make his classes popular, and thus to disseminate a scientific spirit in Italy. At Rome the laboratory of practical physics was originally in a church building, but was removed in 1881 to the Istituto di Panisperma. A weekly colloquium was instituted at an early stage, and the names of Alfonso Sella, Eugenio Beltrami, and Vito Volterra are among those who derived inspiration from him.

To physicists outside Italy Prof. Blaserna's name will be familiar in connection with the Accademia dei Lincei, of which he was president for twelve years, up to December, 1916. Although his duties left scanty time for research, Prof. Blaserna made important contributions to science connected with electromagnetic induction, determination of refractive indices, tangent galvanometers, and the polarisation of the light of the corona in the eclipse of 1870. Of practical problems, that of the design of the best form of amphitheatre was solved by him and applied to the construction of his classroom; this problem also led to a study of certain properties of Z and Gamma functions. Much work of national importance was also entrusted to Prof. Blaserna, who figured prominently in many proceedings of the Second Chamber. He was keenly interested in music, which he studied from the acoustical point of view, and he was instrumental in standardising the concert pitch for Italy, besides writing a popular treatise on sound and music.

G. H. B.

NOTES.

IN a long list of promotions in, and appointments to, the Order of the British Empire, made on the occasion of the King's birthday, we notice the following names of men who have been honoured for scientific services in connection with the war:—*Knights Commanders (K.B.E.)*: Col. H. E. F. Goold-Adams, late Controller, Munitions Inventions Department; Mr. Horace Darwin, F.R.S., chairman, Cambridge Scientific Instrument Co., Ltd., member of Munitions Inventions Department Panel; Lt.-Col. A. G. Hadcock, F.R.S., managing director, Sir W. G. Armstrong, Whitworth and Co., Ltd.; Dr. A. C. Houston, director of Water Examinations, Metropolitan Water Board; Mr. H. D. McGowan, managing director of Nobel's Explosive Co., Ltd.; Prof. T. H. Middleton, Deputy Director-General, Food Production Department, Board of Agriculture; Col. Sir Frederic L. Nathan, chairman, Standing Committee on the Causes of Explosions at Government and Controlled Factories, Ministry of Munitions, chairman Advisory Committee on Alcohol Supplies for War Purposes; Mr. A. Nimmo, president, Mining Association of Great Britain, chairman Board of Trade Committee on the Coal Trade after the War, member Central Coal and Coke Supplies Committee; Admiral Sir Richard H. Peirse, Naval Member of the Central Committee of the Board of Invention and Research; Mr. P. L. D. Perry, Director of Mechanical Warfare, Ministry of Munitions; Mr. J. W. Restler, chairman, Metropolitan Munitions Committee, chief engineer Metropolitan Water Board. *Commanders (C.B.E.)*: Prof. E. C. C. Baly, F.R.S., professor of chemistry, Liverpool University, Deputy Inspector of High Explosives, Liverpool Area; Dr. J. Barcroft, F.R.S., Superintendent of Physiological Investigations, Chemical Warfare Department, Ministry of Munitions; Mr. Conrad Beck, president, British Optical

Instrument Manufacturers' Association; Dr. H. N. Dickson, professor of geography, University College, Reading, Head of Geographical Section, Naval Intelligence Division, Admiralty; Prof. H. B. Dixon, F.R.S., professor of chemistry, Manchester University; Prof. A. S. Eve, F.R.S., Resident Director of Research, Admiralty Experimental Station, Parkeston; Prof. E. C. K. Gonner, professor of economic science, Liverpool University, Director of Statistics, Ministry of Food; Mr. C. H. Wordingham, president, Institution of Electrical Engineers, Director of Electrical Engineering, Admiralty. The list of several hundreds of Officers of the Order (O.B.E.), published on June 7, includes the names of a number of men of science.

THE creation of extensive hay dumps for Army requirements tends to bring into prominence the question, which is ever-recurrent in agricultural practice, as to the extent to which spontaneous ignition may take place and the conditions that are favourable to it. The commonest cases of spontaneous heat production are, of course, those in which living material, seeds, leaves, etc., undergo a "sweating" process when placed in heaps, and this change, which is associated with respiratory and enzymic changes, also proceeds to a certain extent in stacks of green or fresh hay. A much more potent effect is, however, exerted by the growth of micro-organisms, bacteria, and moulds, some of which have been shown to be capable of raising the temperature to upwards of 70° C. Beyond this temperature it is doubtful whether even these organisms can continue growth, and this view is supported by the fact that only carbon dioxide, and not inflammable gas, is produced, but the high temperature already attained, and possibly the products of microbial action, serve to initiate purely chemical oxidation changes, which eventually raise the temperature to the region of 90°–95°. During this phase the hay assumes a dark brown or black colour, small quantities of formic acid are produced, and there is a loss of pentosans and other nitrogen-free constituents. The latter temperature is, of course, unable to give rise to firing, but in view of the fact that substances such as bran become pyrophorus on exposure to temperatures of 145°–175°, and that energetic changes take place as low as 130°, it has been assumed that a prolonged action at the temperature occurring in the haystack may also result in the formation of similar pyrophorus substances. The presence of moisture and of easily decomposable compounds and a free air supply are predisposing conditions to excessive heating.

SOME interesting notes, which someone should collect, have been made from time to time by competent observers in regard to the behaviour of various animals under the terrific conditions of noise, vibration, explosion, and other disturbances at the front. Thus it seems clear that some kinds of birds, under the dominance of instincts of feeding, nesting, or brooding, behave as if they were indifferent to the most conspicuous anomalies of their environment. Living creatures of many kinds are not in the least impressed by sounds which have no interest for them. Just as human perceptions are affected by pre-established concepts, so the intensity of animal sensations is affected by previously established associations. To terrific disturbances, which have neither inherited nor acquired "meaning," an acutely sensitive organism may remain quite indifferent. The cuckoo's calls are not interrupted by the thunderstorm. But another point is raised by some observations which Capt. W. Neilson Jones has just sent us. These refer to the diverse ways in which sheep and cows react to dummy bombs released from an aeroplane. The cows seem entirely indifferent to the "swish" of the falling bomb, but the sheep "invariably scatter in panic." The first question is whether this can be taken as a well-established fact, and the answer must take the form of a considerable number of precisely and impartially observed cases. Supposing it to be a fact, we face the second question of interpretation. Have the cows a different—more placid—temperament? But how excited they get at times by the buzzing of flies that cannot hurt them. The excitement is probably due to fallacious association with the buzzing of blood-sucking flies which can hurt them; and Capt. Jones's suggestion is that sheep are panic-struck because the swish of a falling bomb is probably not unlike the sound of a bird of prey, say a golden eagle, swooping upon the lambs. Susceptibilities of ancient origin may prove very persistent, as Mr. Robinson has so well shown in his suggestive book "Wild Traits in Tame Animals."

COUNT A. DE LA BAUME PLUVINAL, Sir Frank Dyson, and Prof. F. Schlesinger have been elected foreign members of the Society of Italian Spectroscopists.

ON the recommendation of the council of the Royal Society of Arts, the Albert medal for 1918 has been awarded to Sir R. T. Glazebrook "for his services in the application of science to the industries of peace and war, by his work as director of the National Physical Laboratory since 1899, and as chairman of the Advisory Committee for Aeronautics."

ACCORDING to a correspondent of the *Times* (June 8), a severe earthquake was recorded at the Sydney Observatory on the preceding day. The epicentre is placed, probably on the evidence of the seismogram, in Keppel Bay, on the east coast of Australia, about 650 miles north of Sydney. The strength of the earthquake is evident from the fact that the north-eastern towns of New South Wales, not less than two hundred miles south of Keppel Bay, were severely shaken. The chief interest of this shock lies in its occurrence in a district which is rarely visited by earthquakes.

IN view of the public interest which is being taken at present in the Madsen machine-gun, we note that the *Engineer* has reprinted in its issue for June 7 a description of this gun, which first appeared in our contemporary on March 10, 1916. The article includes photographs of the weapon, and also a set of drawings showing the arrangement of the breech mechanism. It is impossible to attempt any description of this mechanism here on account of its complicated nature, and readers interested should refer to the original article.

WE regret to note that the *Engineer* for June 7 announces the death of Mr. Thomas Aitken on May 27. Mr. Aitken was road surveyor for the Cupar district of the County of Fife during the last thirty-six years. His invention of a road-tarring machine brought him into prominence during the introduction of the motor-car, and his machine gained the gold medal and the prize of one hundred guineas at the Road Surveyors' International Competition at Staines in 1907. His book, "Road-making and Maintenance," has now become a standard work. He was a member of the Institution of Civil Engineers.

WE learn from *Science* that Mr. W. Hague Harrington, one of the best known of the older Canadian entomologists, died on March 13 at Ottawa, Canada, at the age of sixty-six years. Mr. Harrington was one of the founders of the Ottawa Field Naturalists' Club, and at one time was president of the Entomological Society of Ontario. In 1894 he was elected a fellow of the Royal Society of Canada. For many years his main interest in life was entomology, and he brought together a large collection of Canadian Coleoptera and Hymenoptera. He was a systematist of recognised standing, and probably the highest authority on Hymenoptera in the Dominion of Canada.

PROF. P. GIACOSA gives elsewhere in this issue his impressions of the recent visit of university representatives from Italy to some of our educational institutions. The Italian delegation, which was invited by the British Government to visit the universities of the United Kingdom, consisted of Profs. Arcangeli, Bianchi, Borgese, Columba, Credaro, De Viti de Marco, Giacosa, Lori, Nasini, Romagnoli, Ruffini, and Volterra. For various reasons Profs. Borgese, De Viti de Marco, and Romagnoli were unable to accept the invitation. Prof. Ruffini, who was detained in Rome on political business, delegated Prof. Galante to represent him. The delegates visited Winchester, Portsmouth, London, Oxford, Cambridge, Leeds, Manchester, Sheffield, Edinburgh, and Glasgow.

THERE have been several rumours during the last few months to the effect that the Germans were building even larger raiding aeroplanes than the Gothas with which we are already acquainted, and it now appears that these rumours were well founded. A giant machine has been recently brought down in France, of which some particulars appeared in the *Times* for June 8. The information given shows that the machine had a span of about 140 ft. and a length of about 70 ft. The weight, fully loaded, was about 14½ tons, of which two tons consisted of bombs. The machine carries four engines of 300 h.p. each, and the speed is stated to be seventy-five to eighty miles per hour. If these figures are correct, the aeroplane in question appears to be the largest machine which has yet been flown. It is not by any means definitely established that the largest possible bombing machines will be the most effective; indeed, it is reasonable to suppose that a larger number of smaller machines with a higher speed would be the more effective and less easy to attack. The larger a machine becomes, the more difficult it is to land in the dark, and the more vulnerable it will be when there is a chance of definite aim from the ground or of attack by fighting machines. While this new development is highly interesting from the point of view of the possible development in the size of machines, it does not seem likely that these giant aeroplanes will appreciably increase the effectiveness of the enemy's night raids.

MR. FRANK HARWOOD LESCHER, who died on May 12, aged seventy-five, was for many years one of the best-known men in the wholesale drug trade, into which he made his entry more than sixty years ago. As a student he distinguished himself by carrying off the medal for botany and materia medica, a success which was soon followed by the Pereira medal, the blue ribbon of the Pharmaceutical Society. In after-life materia medica remained his favourite study, the results of which were, to a considerable extent, embodied in his "Recent Materia Medica," in which all the newer remedies were ably discussed. Averse to publicity, his contributions to the current journals were not numerous, but his work was, nevertheless, continuous and his store of knowledge profound. Those who were fortunate to hear it will not readily forget the fascinating and scholarly address delivered a short time ago to the students of the Pharmaceutical Society, in which he summed up the results of his researches on the drug-routes of the world. By his death a genial, active, and intellectual worker has been lost.

THE interim report of the Gas Traction Committee, noticed in NATURE of May 9, p. 188, referred to the need for experiments and tests in connection with the determination of factors affecting portable gas-generating plants, and the commercial use of gas for traction purposes in containers at high pressures, together with questions relative to liquefaction, absorption, and enrichment, as well as in regard to improvements in the existing arrangements for effecting the admixture of gas and air in the requisite proportions under varying conditions. A sub-committee of the Gas Traction Committee has now been appointed for the purpose of giving effect to this recommendation and of furnishing periodical statements on it. The sub-committee consists of Sir Boverton Redwood (chairman); Lieut.-Col. R. K. Bagnall-Wild, Mr. W. Worby Beaumont, Major A. McN. Cooper-Key, Prof. C. Vernon Boys, Major B. Hopkinson, Mr. E. S. Shrapnell-Smith, and Mr. S. Straker, with Mr. Cecil H. Lamb, of H.M. Petroleum Executive, as secretary.

THE death of M. Jules Lachelier, at the age of eighty-six, which occurred recently, deprives us of an eminent French philosopher who marked a distinct stage in the development of the philosophical movement of his country. He linked Poincaré and Boutroux and Bergson with Ravaisson and Maine de Biran. Lachelier was not widely known, and he contributed very little to philosophical literature—two volumes on "Le Fondement de l'Induction" and an edition of Leibniz—but his influence as a teacher was immense. His own philosophical theory was a refined form of idealism which goes for its origin direct to Leibniz. A science of Nature, he held, would be an impossibility if the laws of thought were not at the same time, as Kant maintained, the constitutive laws of Nature; but he went further than Kant, believing that there is a method, which he named reflection, by which thought possesses itself in its very essence, and has nothing to seek beyond. Sensible knowledge he conceived, in the manner of Leibniz, as an obscure form of intellection. His chief work and his influence dates back to the years 1864 and 1877, during which period he lectured regularly on philosophy as Maître de Conférences in the Ecole Normale Supérieure. In the latter year he was appointed Inspecteur Général de l'Instruction publique. Since 1901 he lived in practical retirement, but continued to take a keen interest in philosophy, especially as a member of the Societé Française de Philosophie, assisting in discussions and in the work of producing the "Vocabulaire philosophique." He died on January 18 last at Fontainebleau.

IN 1896 Dr. Guiliano Vanghetti, an Italian physician, when seeking to ameliorate the condition of the hapless soldiers who had been mutilated by the Abyssinians after falling into their hands as prisoners of war, conceived the idea of utilising the muscles in the stumps of amputated limbs as the "driving-power" for artificial limbs. The technical difficulty of yoking such muscles to the levers of artificial limbs proved to be very great, and up to 1914 only twenty patients had been operated on. With the outbreak of the present war this new departure of surgery—the "kinematisation of stumps"— was taken up by a young Italian surgeon, Prof. V. Putti, professor of orthopædic surgery in the University of Bologna and director of the Rizzoli Institute. Prof. Putti has improved the technique needed to make such operations a success, and has now operated on fifty cases. His patients, by means of muscles retained in the stumps of their limbs, are able to execute movements in artificial hands, knees, and feet. During a recent visit to England Prof. Putti demonstrated his methods and results to British surgeons, and convinced them that this new departure in surgery deserves their most favourable consideration. The muscles of the stumps are yoked to artificial levers by various devices, and it is surprising how the parts become tolerant of the abnormal burdens placed on them by the surgeon. The patient is even able to estimate the weight of the load which he attempts to lift. For success the surgeon depends on the intelligence and perseverance of his patients as much as on his own technical skill. It would be wrong to give rise to the hope that "kineplastic" surgery can ever give a limbless man conditions of movement comparable to those he has lost, but this new departure in surgery does promise an amelioration of our former helpless outlook. Prof. Putti has presented models and casts of "kinematised stumps" to the museum of the Royal College of Surgeons of England.

APPRECIATIVE notices of the work of Mr. C. D. Ahrens, who died on March 14, at eighty-one years of age, are contributed to the Journal of the Quekett Microscopical Club by Mr. E. M. Nelson and Prof. F. J. Cheshire. We extract the following particulars from Mr. Nelson's notice:—Mr. Ahrens was a prism and spar slitter. He made Nicol prisms and analysers, quartz and calcite prisms of all kinds, as well as the glass prisms for Wenham binoculars. In 1867 he designed a binocular upon quite a novel plan. The rays issuing from the back of the objective were separated to an angle of 15° by a double-image calcite prism; these rays were then crossed over by two flint prisms, to correct the chromatic dispersion. The rays used were the extraordinary, the ordinary being diverted out of the path. The tubes were equally inclined to each other. In 18[illegible]1 he introduced another new binocular, in form like Stephenson's. It had parallel tubes, but they were bent as in the Stephenson. The ingenious part of the arrangement was that the beam from the back of the objective was divided by two Wollaston camera-lucida prisms placed back to back; these deflected the rays right and left, then another prism with two reflections bent them up the tubes. Probably a carefully made binocular on this plan would be a very successful instrument. In 1884 he designed a bent-tube erecting monocular microscope; obviously a most useful instrument, it is surprising that some energetic manufacturer has not taken up this idea. In the same year Mr. Ahrens designed a new polarising prism, which was further improved by Mr. H. G. Madan in 1885. In 1886 he brought out yet another improved form of polarising prism, the object of which was to lessen the ratio of its length to its breadth. That of the Nicol is about 3 : 1, while the Ahrens was $1\frac{1}{2}$: 1. In 1887 he made an erecting microscope the design of which has had far-reaching consequences. The erection was obtained by Porro prisms. It was Ahrens who first brought the long-forgotten Porroprism to remembrance.

WE have received the Report of the Bacteriologist, State Board of Agriculture, Michigan, for the year ended June 30, 1917. Much work has been done on contagious abortion of cows. Vaccines prepared with the *Bacillus abortus* did not prevent infection with succeeding abortion in guinea-pigs. The bacillus soon dies out on wool, silk, and in soil; on the two former materials within a fortnight, and in soil within a week. Cultivations of leguminous bacteria have been tested as fertilisers for leguminous crops. On alfalfa they seem to be of benefit in about one-third of the crops treated, but on other crops no definite conclusion has yet been reached.

THE Report of the Departmental Committee appointed to inquire as to precautions for preventing the danger of infection by anthrax in the manipulation of wool, goat-hair, and camel-hair has just been issued. (Cd. 9057). The Disinfection Sub-Committee concludes that anthrax can only be prevented either by preventing the disease among animals or by the destruction of the organisms in the wool or hair. The Sub-Committee has devised a process for the last-named purpose, the essential features of which are:—(1) Treatment of the material with a warm aqueous solution of soap containing a little alkali, followed by squeezing between rollers; this disintegrates the blood-clots. (2) Treatment with a warm solution of formaldehyde in water and again squeezing; this destroys most of the spores. (3) Drying and standing for a short time, by which any remaining spores are killed. The Committee is of opinion that the Government should undertake the work of disinfection at a central institute or station. For the treatment of 10,000,000 lb. of wool annually the cost of the central station is estimated to be 18,000*l.*, and the working cost to be from 0·544*d.* to 0·824*d.* per lb. of untreated material. These figures were computed at pre-war prices, and about 75 per cent. would have to be added to meet present-day conditions.

CAPT. E. G. FENTON discusses in the May issue of *Man* the remarkable cart-ruts found in Malta. It has been formerly assumed that they date from prehistoric times, and that they probably belong to the Neolithic period. There is no sign of a groove cut by horses' feet between the ruts, and the suggestion has been made that they are the result of human power in the shape of a number of men drawing waggons, and that the Neolithic civilisation was brought to a close by a period of desiccation, such as that discussed by Ellsworth Huntingdon in "The Pulse of Asia," the dawn of our Mediterranean historical period being heralded by the increase of moisture. Capt. Fenton, on the whole, believes that they date from the early part of the Iron age, at a time when the Mediterranean was moister and the island was capable of supporting a larger population than under present conditions. The suggestion that these climatic changes can be equated with events in Egyptian history is interesting, but the evidence is scarcely sufficient to support any definite conclusion. Prof. Boyd Dawkins, in the June issue of *Man*, asserts that the ruts are "due to the weathering of the rock under vaporal conditions. They are merely the ordinary joints, widened and eroded by the rain-water containing carbon dioxide, familiar to geologists in all limestone plateaux, and to be seen over very wide regions in Southern France."

A RESEARCH of interest to veterinarians and zoologists on the efficiency of some Anthelmintics has been published by M. C. Hall and W. D. Foster (*Journ. Agric. Research*, vol. xii., No. 7, 1918). By comparing the number of worms evacuated after the administration of various drugs with those found in the digestive tracts of "patients" killed a few days later a sort of "percentage efficiency" can be calculated. The number of experiments of this kind is necessarily limited, but the result in nearly all cases is disappointingly low. Dr. H. E. Cross has been trying the effect of various emulsions intended to protect camels from the attacks of blood-sucking flies (Bull. 76, Agric. Research Inst., Pusa); he finds that the only serviceable agent is castor-oil, which is too expensive for practical use.

A SYSTEMATIC zoological paper of more than usual interest is Mr. J. Hewitt's "Survey of the Scorpion Fauna of South Africa," which constitutes part ii. of the Transactions of the Royal Society of South Africa (vol. vi., 1918). The region has a large number of genera and species, which are described in detail with the help of structural drawings and admirably reproduced photographs. The author takes occasion to discuss the bearing of the variation of features of systematic importance on questions concerning the factors of evolution, and concludes:—"In view of the continuous variability of most of the characters employed in the distinction of species amongst our scorpions, it seems probable that discontinuity arises most frequently through the elimination of intermediate forms rather than by mutation processes."

IN his latest studies on American Permian vertebrates (Contributions from Walker Museum, Chicago, vol. ii., No. 4), Prof. S. W. Williston discusses the origin of the vertebræ in the amphibians and reptiles, and shows that all stages in the development are now known. Inheriting separate pleurocentra, hypocentra, and neural arches from the early fishes, the land-vertebrates soon consolidated their centra, until in later reptiles the only remnants of the primitive condition are certain wedge-bones and some separate parts in the atlas and axis. Among other notes Prof. Williston also describes and illustrates some fine specimens of the brain-case of Eryops, Edaphosaurus, and Dimetrodon.

PROF. ROLLIN D. SALISBURY, in his address to the Section of Geology and Geography at the Pittsburgh meeting of the American Association for the Advancement of Science (*Science*, April 5), urged the claims of geology as a factor in general education, and pointed to modern geography as having even greater promise. Like Mr. Bateson in the "Cambridge Essays," he feels that "the type of subject which works on strictly mathematical lines cannot, by itself, afford the best preparations for the solution of the average problems of the average man." We require a "training in the methods by which uncertainties are cleared up," and the sciences concerned with Nature in the field furnish this training to a marked degree.

IN the Quarterly Journal of the Geological Society of London, vol. lxxiii., p. 1, Dr. A. Smith Woodward describes two additional cranial fragments and a molar tooth of Eoanthropus, which were discovered by Mr. Charles Dawson at Piltdown in 1915. Since one fragment is occipital, and the same region is represented in the imperfect skull originally described, there is no doubt that we now possess traces of a second individual. The paper is rendered still more valuable by an appendix by Prof. G. Elliot Smith, and by the printing of the discussion, in which Mr. Pycraft, Prof. A. Keith, and Sir Ray Lankester took an important part. Attention may be directed to Mr. Pycraft's comments on a ramus of the mandible of a chimpanzee with worn molars, sent him by Mr. G. T. Miller, who, as is well known, opposes the attribution of the Piltdown jaw to the skull fragments associated with it in the gravels.

A WRITER in the *Zeitschrift für angewandte Chemie* for March 22 estimates the available water-power in Germany at 11·4 million h.p., only about four millions being yet utilised. In 1910 the proportion utilised was only 5 per cent. of the steam-power produced, while in France the percentage has reached 40 per cent.

THE restoration of Alsace to France would put the latter country in possession of the valuable potash deposits discovered in 1904. These rich deposits cover an area of seven square miles, to the north-west of Mulhouse. The workable yield is estimated at 300 million tons, and they could be made to yield an annual output of 800,000 tons at a low cost of production. According to the *Zeitschrift für angewandte Chemie*, March 22, fifteen shafts have already been sunk, but production has been hampered by legal restrictions arising out of the German potash laws.

ACCORDING to a writer in the *Berg- und Hüttenmannischer Jahrbuch*, part i., 1917, there are extensive, unworked deposits of manganese ore in the Bukovina which reach into Rumanian territory. The article describes the deposits and the methods of working them. Analyses made show the yield of metallic manganese to be 40·65 per cent. The ore occurs in some parts in the form of outcrops, thus making it cheap and easy to win. Another authority, writing in *Stahl und Eisen* for April 4, estimates the quantity of manganese ore in the Kutais Government of Russia as thirty million tons, and in the Yekaterinoslav Government about eleven million tons. The possession of Batoum by the Turks should enable them to control the entire output of the deposit first mentioned, while the peace made with the Ukraine brings the second source of supply within the range of German influence.

FOR the making of chemical manufacturing plant chemists and metallurgists have long sought some form of metal which will resist the corrosive action of acids. Such a metal would have obvious advantages over the stoneware or similar breakable material ordinarily employed. In the laboratory it has long been known that iron could be made resistant to either sulphuric or nitric acids by alloying it with a certain proportion of silicon or chromium, but it is only recently that successful use has been made of this acid-resisting property on a large scale for chemical installations. In the Journal of the Society of Chemical Industry for March 30 Mr. S J. Tungay gives an account of what has been done in this country and abroad towards the industrial production of acid-resisting iron. Considerable manufacturing difficulties have had to be overcome, but British metallurgists are now able to produce a large variety of vessels and plant suitable for the making of sulphuric and nitric acids; the material employed is understood to be an iron-silicon alloy containing a small proportion of one of the rare elements. Since the outbreak of war the metal has been found a great boon in condensing the nitric acid required for high explosives, as by making use of it large nitric acid plants were installed very rapidly; moreover, the condensing efficiency obtained was high, since the alloy possesses a heat conductivity about ten times that of stoneware.

WE have received from the Controller of Munitions Mineral Oil Production a report on "The Production of Fuel Oil from Ordinary Gas-works Plant." In view of the peculiar and difficult conditions now obtaining, the technical advisers of this Department realised that existing apparatus and trained staffs must be employed, and they appear to have gone a long way to solve a problem of the greatest urgency. Without betraying any official secrets, it may be said that the enormous deposits of cannel and bastard cannel which occur in this country are being explored and tested with a view to the production of an indigenous oil supply. It is obvious that our almost complete dependence on foreign sources for fuel oil, gas oil, benzine, and kerosene is a weakness that the enemy has not been slow to realise, and it is a matter for congratulation that on the eve of the fifth year of war the authorities have decided to prosecute their search for substitutes. It appears that the researches of the Department indicate that excellent yields of tar can be obtained from cannel coal—a fact which is by no means novel, seeing that, in the distant past, there actually was existent in Staffordshire a home oil industry. Where the present report, however, achieves novelty is in the production, at suitable temperatures, of not only a good yield of tar, but also an excellent production of gas and of sulphate of ammonia. It has commonly been considered that a good gas make indicates a low oil production, and *vice versa*. The Department, however, by means of a compromise on temperature and by various modifications of standard gas-works technique, has, without doubt, made a distinct step in the direction of producing ample supplies of fuel oil compatible with the maintenance of the gas output.

In a communication to the Journal of the Röntgen Society, vol. xiv., No. 54, January, 1918, Mr. C. A. Schunck describes a series of tests made to ascertain the region of the ultra-violet spectrum that produces the greatest therapeutic effect. The several parts of the spectrum were isolated by the absorption of weak solutions of quinine sulphate, salicylic acid, and phenol, or by glass plates. The therapeutic effect was observed by exposure of the operator's forearm to the screened rays for definite periods of time, and note was taken of the reaction produced. The greatest effect appears in the region 2500 to 2350 Å.U.; the boundaries, however, of this region are not sharply marked.

Engineering of May 31 contains an account of the new Tröllhattan Canal, connecting Lake Vänern with the Kattegat. Sanctioned by a Parliamentary vote in May, 1909, the waterway in October, 1916, had reached a stage which enabled it to be opened to traffic, and the ceremony was performed by the King of Sweden. The project is really one of old standing, dating back to the days of Gustavus Vasa, who initiated steps for linking up Lake Vänern with Tröllhattan by means of a navigable waterway. The first lock was opened in 1607. It was not, however, until 1800 that through connection was established to Gothenburg. Various extensions have since been carried out, culminating in the development called the new canal, the cost of which has somewhat exceeded a million and a quarter sterling. The enlarged waterway, which is fifty-two miles in length, is adapted for vessels generally up to 13 ft. draught, but the locks, which are six in number, enabling a change in level of 140 ft. to be negotiated, are constructed to pass vessels of $16\frac{1}{2}$ ft. draught, this being a provision to meet likely developments in the near future. Each of the lock-chambers has a length of 320 ft. and a width of 45 ft., with a depth of 18 ft. of water over sill. The canal has a mean bottom width of 79 ft. The traffic during last year amounted in the aggregate to 9759 vessels, totalling 870,668 tons. Of this number 7827 were steamers, 664 sailing vessels, and 1268 barges. The undertaking was designed and carried out under the direction of the Royal Waterfalls Board.

OUR ASTRONOMICAL COLUMN.

KODAIKANAL OBSERVATORY REPORT.—The report of the Director of the Kodaikanal Observatory for the year 1917 has been received. The weather during the year was generally unfavourable, according to Indian standards, but substantial progress in many departments of solar research is recorded. Direct photographs of the sun were obtained on 294 days, monochromatic images of the disc in K light on 328 days, prominence plates on 262 days, and H_α disc plates on 255 days. Judging by the mean latitude of spots, it would appear that the maximum of the sunspot cycle was not reached, though the northern hemisphere may possibly have attained its greatest activity. The prominences, with a mean daily number of 19·8, were in excess of those recorded in 1916; the northern hemisphere continued to be more active than the southern, as regards both prominences and spots, and also as shown by prominences projected as absorption markings on the disc. Work with the large grating-spectrograph included the spectrum of Venus (see NATURE, vol. ci., p. 192), sun and arc comparison spectra, and the spectrographic determination of the solar rotation, in addition to experimental work on the "pole effect" in the iron arc. It has been found that most of the iron arc lines in the region between 4337 and 4494 show a tendency to shift towards the red with increasing exposure time, indicating that they are unsymmetrically widened towards the red to a very slight degree. The vertical motion-shift of 3 km./sec. reported by Perot for the B group of oxygen (telluric lines) was not confirmed by observations made at Kodaikanal. An attempt to photograph the conjunction of Regulus and the sun on August 22, in infra-red light, was unsuccessful, but the sky was not sufficiently clear to give a satisfactory test of the method. Time determinations and meteorological and seismological observations were also carried on.

ANNUARIO OF THE RIO DE JANEIRO OBSERVATORY.—The thirty-fourth issue of this useful almanac of 524 pages fully maintains the high standard of previous years. It is divided into four sections, dealing respectively with astronomical data for 1918, a collection of tables for the reduction of astronomical observations, geophysics and climatology, and a summary of meteorological observations made at thirty-three stations in Brazil. It is interesting to note that the tables include details of the corrections to be applied to the tabulated times of rising and setting of the sun and moon in order to obtain the corresponding data for other parts of the country; the inclusion of such data in our own official almanac would doubtless be generally welcomed. Since 1660 the magnetic declination at Rio de Janeiro has varied from 12° E. to its present value of about 11° W., and may be approximately represented by a formula given by the director of the observatory, Dr. H. Morize, namely, $d=5{\cdot}6^\circ+0{\cdot}08^\circ t+8{\cdot}0^\circ \sin(0{\cdot}73^\circ t-44{\cdot}1^\circ)$, where t is the interval in years from 1850 taken as zero.

ALEXANDER THE GREAT AND HIS CELESTIAL JOURNEY.

PHOTOGRAPHS were given in NATURE of August 23, 1917, and March 14, 1918, of traditional representations of Alexander, seated in a car drawn by flying griffins, from St. Mark's, Venice, and Bâle Cathedral, and it was conjectured that a diligent hunt would reveal many similar examples in Europe and England. Since then an article by Prof. R. S. Loomis has appeared in the *Burlington Magazine* of April and May, which shows that the author had been engaged already in a research on the subject of Alexander's celestial journey. Prof. Loomis gives copious references to earlier authorities, with the addition of more than a score of photographs of other examples of the representation, in which we are pleased to find some ten are taken from English churches and cathedrals, as Wells, Chester, Lincoln, Gloucester (surely Canterbury), and Beverley Minster, Cartmel Priory, Whalley Church, St. Mary's Darlington, and Charney Bassett, Berks.

The figure of Alexander can be recognised by the two spears he carries in his hands, baited at the end with a tasty lure to guide the griffins alongside to bear him aloft. They are not sceptres, or distaffs even, in the mistake of the local designation (Borgo-

San-Donino) of the subject as "Berta che filava"; and chains are shown as traces to harness the griffins. The detail of the mosaic pavement, A.D. 1165, in Otranto Cathedral bears the name Alexander, to prove there is no doubt of the subject.

FIG. 1.—Detail of mosaic pavement, A.D. 1165, Otranto Cathedral. From the *Burlington Magazine.*

In "Dynamics of Mechanical Flight" (1912) I have given, on p. 7, a vignette representation from an English MS. in the British Museum, bearing a strong resemblance to the Tournay tapestry in Fig. O of Prof. Loomis's article. The subject was thus evidently a favourite as familiar to readers of medieval romance.

Photo] [*G. C. Druce.*

FIG. 2.—Detail, about A.D. 1345, from Gloucester Cathedral. From the *Burlington Magazine.*

Prof. Loomis tells us (p. 136) that the story of Alexander the Great is not to be found in the earliest body of romantic Alexander tradition of the Greek Pseudo-Callisthenes, but must be considered a late medieval or Renaissance interpolation. But no mention of this can be found in the edition by Carolus Müller, 1846, in the Reading Room of the British Museum, where the Greek version of the Pseudo-Callisthenes is given in chap. xli., book ii., p. 91.

The legend was familiar to Chaucer, from the reference to it in his "House of Fame":—

> for never halfe so hye as this
> N'as Alexander of Macedon
> King—ne of Rome dan Scipion,
> That saw in dreame at point devise,
> Heaven and Earth, Hell and Paradise,
> Ne eke the wretch Dedalus,
> Ne his childe nice Icharus
> That flew so hie that the hete
> His wyngs molte, and he fel wete
> In midde the sea, and there he dreint,
> For whom was made a great complaint.

Chaucer returns to it in "The Squieres Tale," alluded to by Milton as the one—

> that left half told
> The story of Cambuscan bold
> And of the wondrous steed of brass
> On which the Tartar king did ride—

the subject of the Scribe-Auber opera of "The Bronze Horse" ("Le Cheval de Bronze") in the Tartar-Chinese legend. In the Chinese euphemism the Emperor is said to mount the dragon when he ascends to heaven.

Prof. Loomis traces Greek inspiration in the bas-relief on St. Mark's, and conjectures it was brought from elsewhere as a trophy of war. Later ages, he tells us, identified Alexander with Antichrist and Lucifer, for his impious experiment and scientific research.

Here is an opportunity to rectify the omission of the interpretation of the line in the ode to Archytas (NATURE, March 14),

> animoque rotundum percurrisse polum,

as a reference to another of the mathematical text-books of Horace's schooldays, the treatise of Archytas on Spherics, what we call the Use of the Globes, a study highly commended by Lord Kelvin for its stimulus.

G. GREENHILL.

THE VISIT OF DELEGATES FROM ITALIAN UNIVERSITIES.

IF the British Government in courteously inviting a delegation from the Italian universities to make a tour of England and Scotland in order to inspect the higher educational institutions of the United Kingdom had as its purpose to show to the Italians to what an extent the war had exercised an influence on national studies, and how far the students had participated in the work of military preparation and in the risks of the war, certainly that purpose was fully achieved. The Italian professors, welcomed in the historic university towns and in the other centres of knowledge with the utmost kindness, found the halls and colleges empty and transformed into barracks for troops. It is precisely the same in Italy, where, except for the medical students, who have been sent back from the front in order to complete their studies, the schools have been practically closed. Among the Italian professors and students the killed and wounded are numerous. It has always been a tradition of the educated youth of Italy to lend its aid to national movements, and in the present war the first sign of the decision of Italy to intervene with those who are now our Allies was given by the university classes, either as active participators in the work of government or as members of the body of students.

But the Italian professors had yet another mandate, that, namely, of making themselves acquainted with the course of education in Great Britain and of comparing it with that of their own country. However the external forms of the various English universities may differ among themselves, and differ from ours, we have found that, after all, the foundation and the intrinsic value are the same. With regard to the English didactic method, we have been struck by a greater tendency towards a systematic arrangement and simplification of methods; one receives the impression that the whole system of English education is based much more on visual representations than is the case with Italian methods, which are more verbal and abstract. This is particularly apparent and important in connection with primary and secondary instruction, which makes an excellent impression, both on account of the intuitive basis of the education and the distribution of subjects and time, as well as on account of the large part which is devoted to moral and physical training. In her conception of what elementary and secondary schools should be, both intrinsically and extrinsically (methods of teaching and scholastic buildings), England offers a notable example, which is worthy of study, especially by us Italians, for whom these problems are of the greatest importance, as the Government and the people are fully aware.

With regard to the universities, on the other hand, we were able to pursue our journey in company with English men of science, trusting to those spiritual affinities which have hitherto been of such great value in strengthening the friendship between our two peoples. Our visit to certain universities which were more particularly technical gave us great satisfaction for a different reason, since they showed us that they were well on the way towards that co-operation between the man of science and the industrialist which, with ourselves, has recently proved to be very effective. It is in virtue of a similar co-operation that the Italian universities have now, in some branches of education, an abundance of means which ensures their proper working; and it is hoped that not only the physico-chemical sciences, but also the biological sciences, to their full extent and application, will soon be enjoying the benefit of the assistance of the industrialists.

To the Italian delegation it seemed that the reciprocal knowledge of the languages of the two countries was the problem that had, in the first place, to be solved; the meetings at the Royal Society of Literature, the lectures delivered at various places that were visited, did much towards assisting the efforts in this direction, and it was certainly a great encouragement to us, coming from Italy at this grave moment to carry on a work of reconstruction, to find so much willingness expressed in the English manner, not in words alone, but in deeds as well, to spread the knowledge of our language, which is the chief and the most effective instrument of our union.

Piero Giacosa.

APPLIED SCIENCE IN THE COTTON INDUSTRY.

OPINIONS may differ as to which is the most valuable or most important of the many aspects of this question which were set forth by Dr. Lawrence Balls in a paper entitled "Some Applications of Research to the Cotton Industry," read before the Royal Society of Arts on April 10, and published in the Journal of the society for May 3 (vol. lxvi., p. 389). His contributions to the scientific and practical sides of the problem may appeal in varying degrees to different people, but no one could fail to be impressed by their compelling interest.

The necessity for scientific research is in danger of becoming a catchword which everyone repeats, though few have sufficient knowledge of what it means to have any real faith in it. Dr. Balls has shown that the scientific study of the cotton plant and its environment is essential before the spinner can even describe what he wants in his raw material, in terms which can be translated by the plant-grower into efforts to produce the desired results. Even the question of length of staple has always been dependent on a rule-of-thumb method of determination which left the grower very much in the dark. On this point one might be tempted to award the major importance to Dr. Balls's invention of an ingenious machine which will not merely give the maximum and minimum length of individual hairs in a cotton sample, or even the average length, but will sort them out in graduated lengths and make it easy to measure the total quantity of each length, thus ascertaining accurately the degree of uniformity or otherwise of the staple, which is of prime importance to the spinner. The use of this machine should go a long way towards determining in a really definite way the value of any cotton sample, and may prove the main step towards a method which would enable the grower himself to estimate the suitability of a new cotton for a particular trade.

Equally valuable from the practical point of view was the hint which Dr. Balls's studies of flowering and bolling curves give of a scientific method of forecasting such crops as cotton. If it is not too good to be true, we may live to see the "arrivals" of the crop plotted out weeks in advance, and the probable total yield of the crop foreseen with an accuracy which would certainly be an improvement on the present rather haphazard and sometimes very deceptive methods.

The important results of the work out of which much of Dr. Balls's material arose, in its effects on the water control policy of the Egyptian Irrigation Department, is now a matter of history, but it is one which cannot be told too often either in scientific or official circles as an encouragement and stimulus to the one and a warning to the other.

THE CO-ORDINATION OF ELECTRIC POWER SUPPLY.

THE report of the Committee appointed by the Board of Trade to consider the question of electric power has now been issued (Cd. 9062, price 3*d*.). Several of the questions the Committee had to consider have already been dealt with by the Coal Conservation Sub-Committee, the report of which was described in Nature of January 3 and February 14 last. The report begins by the statement of several general conclusions on which it bases its recommendations. The first of these is that after the war the success of British industry will depend to a large extent on the adoption of the most efficient methods and machinery, so that manufacturing costs may be reduced to a minimum. In this connection the extension in the use of electric power supplied at the lowest possible price will be a most important factor. The present system of supply by separate authorities to small areas is economically unsound, and prevents the cheapening of the supply. Hence a comprehensive system for the generation of electricity and, where necessary, for reorganising its supply should be established as soon as possible. With these statements every engineer is in agreement. If it had been possible to work on a clean slate, the devising of a suitable scheme under a central authority would have been comparatively easy. Owing, however, to the existence of the present patchwork system and the many conflicting interests which will have to be adjusted, the problem is one of considerable complexity. The Committee advises that a new body to be called the Electricity Commissioners be set up, to whom the existing powers of the Board of Trade relating to the supply of electricity be transferred. It recommends that the existing system of generating electricity for small areas be abolished. One of the first duties of the Electricity Commissioners would be to divide the country into districts technically suitable for the generation and distribution of electricity. In each district an Electricity Board is to be set up, which will purchase all the generating stations in it. These Electricity Boards are to be financed in whole or in part with Government assistance, and are to make no divisible profits. The Committee laudably strives to conciliate those authorities and engineers who are adversely affected by its proposals. It claims, however, extended powers for the use of overhead wires, wayleaves, and the acquisition of water rights. From the practical point of view the proposals are good, and their adoption, provided that they could be smoothly carried out, would be greatly in the national interests. We hope that Parliament will give to these proposals its most serious consideration.

THE EDUCATION BILL.

THE debate on clause 10, the most important feature of the Education Bill, was resumed in Committee of the whole House on Wednesday, June 5, and continued on June 10 and 11. Sir H. Hibbert submitted, at the instance of many Lancashire Members, an alternative scheme to that of the Bill, whereby, at the option of the local authority, half-time between fourteen and sixteen years of age and thenceforward no compulsory scheme of continued education might be substituted for the proposal in the Bill to require between the ages of fourteen and eighteen a maximum of 320 hours in each year to be included within the ordinary working hours. Mr. Fisher opposed the amendment on the ground that it could not be made mandatory over the whole country, that it would seriously reduce wages, introduce confusion into administration, and would practically double the demand for teachers and for school accommodation. To the great disappointment of many friends of the measure, and especially of this important and vital feature of it, Mr. Fisher, in response to representations not only on behalf of the textile industry, but also in respect of agriculture and of coal-mining, submitted amendments to section i. of clause 10 reducing the compulsory hours in each of the four years from 320 to 280, if the local authority so resolve, and providing that the obligation to attend continuation schools shall not, within the period of seven years from the appointed day on which the provisions of clause 10 (i.) come into force, apply to young persons between the ages of sixteen and eighteen. The Lancashire Members thereupon withdrew their opposition, and Mr. Fisher's amendments were adopted, together with an amendment leaving the local authority free to deal with the times and seasons best suited to the circumstances of each locality. Difficulties of buildings, equipment, and the supply of teachers had doubtless something to do with this decision, but the great advantage gained by the concession is permanently to secure the educational oversight of the adolescent until he reaches the age of eighteen. On Monday Mr. Fisher accepted an amendment by which it was agreed to establish a national scheme for training boys who desire to enter the mercantile marine. Sir Philip Magnus moved to amend subsection 2 in such a way that the recognition of a school as efficient by a British university, equally with such recognition by the Board of Education, should make full-time attendance in that school up to the age of sixteen years a ground of exemption from the obligation to attend continuation schools. After discussion the amendment was withdrawn, and Mr. Fisher agreed to substitute for the words "under arrangements approved by the Board of Education" the words "under regulations made by the inspecting body after consultation with the Board of Education."

It was suggested in the discussion on Tuesday that pressure might be brought to bear upon young persons to attend continuation schools at or in connection with their place of employment. An amendment was afterwards accepted against any such compulsion by a local authority without the consent of the young person or his parents. Clause 10 was finally agreed to as amended.

LIGHT AND VISION.[1]

THE phenomena which take place between the incidence of light on the cornea and the mental appreciation of the fact may conveniently be divided into three stages:—

(1) The production of an image on the retina by means of the dioptric system of the eye. This is purely a physical question, and has been very completely worked out. The only component of a physiological nature is the mechanism of accommodation, by which the curvature of the lens is changed in order to vary the focal length of the system. It would appear that the muscular mechanism here involved is liable to fatigue, and doubtless plays its part in the choice of appropriate methods of illumination, as in the tests used by Ferree.[2] It will also be plain that insufficient illumination requires more exact and tiring accurate adjustment of focus.

(2) When light arrives at the particular layer of the retina known as that of the rods and cones, it excites a photo-chemical change of some kind, which in its turn acts upon the terminations of the optic nerve-fibres and sends along these fibres a series of disturbances which we call nerve impulses.

(3) Arriving at the brain, these impulses are distributed to a complex system of centres composed of nerve-cells, where processes occur associated, in some mysterious way, with the conscious perception of light and illuminated objects.

We naturally ask the question:—What kind of sensation do we experience if the optic nerve is stimulated in other ways, as can be done by means of sufficiently powerful agents? The answer is that whatever be the way in which the optic nerve is stimulated, the sensation is one of light. This statement applies, altering light for sound, taste, etc., to all the nerves of special sense, and is commonly known as Müller's law. In point of fact, it had been formulated by Sir Chas. Bell at an earlier date, though perhaps in not so complete a form. The sensation, then, is an affair of the brain, the "cerebral analysers," as Pavlov calls them, and provided that this part of the brain is set into activity, it matters not by what means, the sensation is the same. This again applies to all the special senses. What, then, is the function of the elaborate structure at the peripheral end of the nerve? Such organs are known in general as "receptors," and their function may be grasped if we try to stimulate the optic nerve by throwing a beam of light upon it. Nothing happens at all, because the nerve-fibres are not responsive to light energy. Some sort of mechanism that is affected by this form of energy must be provided, and is to be found in the rod and cone layer of the retina.

But what is passing along the optic nerve when a light sensation is experienced is identical with that

[1] Abridged from a paper read at the meeting of the Society of Illuminating Engineers on April 16 by Prof. W. M. Bayliss, F.R.S.

[2] Trans. Illumin. Engineer. Soc. (U.S.A.), vol. viii., p. 40, and Ferree and Rand, *ibid.*

passing along the auditory nerve when a sound is heard.

In addition to the rod and cone layer, the retina of the vertebrate contains several layers of nerve-cells. These do not really belong to the receptor organ itself, but are probably of the nature of relays. In the cuttle-fish they form a separate mass, outside the eye itself.

We know that the cones are sensitive to light, because they are the only elements present in the most sensitive spot of the retina, the fovea centralis. That of the rods is more disputed, but their nervous connections are similar to those of the cones, so that it is difficult to believe that they are not also receptors for light.

The only satisfactory explanation of the mode of stimulation of the retina by light is that it is through the intermediation of a chemical reaction brought about by radiant energy of a limited series of wave-lengths. As yet only one substance sensitive to light has been discovered in this situation. This is usually known as "visual purple," but its actual colour would be described by most people as deep rose red.

Remembering, in the first place, Grotthus's law, that light can produce an effect only in proportion as it is absorbed, it is of importance to investigate the absorbent properties of visual purple as regards that part of the spectrum which is visible to us. This has been done by Victor Henri and Larguier des Bancels.[3] They determined the absorption of light by solutions of visual purple, compared it with the degree of chemical action, and also with the minimal amount of light energy required to excite a just perceptible sensation from the peripheral parts of the retina. The determinations were made throughout the visible spectrum, and the three curves show a remarkable agreement. These facts show that visual purple is at least the most important photo-chemically sensitive component of the retina, if not the only one. We note also that there are no absorption bands in its spectrum, so that there is no difficulty with respect to colour vision. An interesting fact comes out from the curve of sensibility of the retina compared with the energy of the light acting. At that particular frequency of vibration corresponding with the yellow-green, the threshold of stimulus coincides with the energy quantum of Planck for that rate of vibration. In other words, the retina is sensitive to as small an incidence of energy as it is possible for it to receive.

Very little is known as to the chemical nature of visual purple. It exists in colloidal solution in a liquid in which the rods and cones are immersed. Although it is not produced in the fovea itself, Dr. Edridge-Green has found evidence that it flows in from surrounding parts.

The best information to be obtained of the course of the photo-chemical reaction is obtained from records of the electrical changes which occur on the incidence of light. The simpler curve given by the eye of the cuttle-fish is to be regarded as indicating the essential part of the phenomenon; the more complex form of the vertebrate curve is probably due to the presence of the extraneous nerve-cells. The chief points to be noticed are the following:—

First, the curve gradually falls, the stimulus merely disappears, on the advent of darkness. There is no indication of a stimulus of any kind produced by darkness. This is contrary to the well-known theory of Hering, according to which the reaction of restoration, occurring when the light ceases, is associated with a positive sensation of darkness. This point of view had been applied to physiological phenomena in general, but is now practically given up.

Secondly, the curve, after it has attained its maximum, remains constant while the illumination lasts.

Thirdly, the reaction does not attain its full intensity suddenly, nor do the products disappear suddenly. In other words, the sensation does not appear at once, nor does it immediately disappear when the stimulus ceases. This is the obvious explanation of the absence of flicker when the alternations of light and darkness are sufficiently rapid. Further, as would be expected from a chemical reaction, the greater its magnitude, the longer it requires for the products to recombine or otherwise disappear. Incidentally, the form of the curve differs somewhat for different colours.

Fourthly, there is a short latent period between the time of incidence of light and the electrical effect. If this is not counterbalanced by a similar period after the illumination ceases, it would result in some deviation from Talbot's law in its physiological aspect, such as has been described by Parker and Patten. The latent period reminds us of the "photo-chemical induction" of Bunsen and Roscoe.

There is reason to believe that the maximum sensibility of the fovea is not when it is the only part of the retina illuminated, but when there is simultaneously a weak illumination of the surrounding parts. This seems to be connected with the production and movement of the visual purple. If it be the fact, its importance in observations with the microscope, the polarimeter, and other optical instruments is obvious.

The explanation of positive and negative after-images is fairly plain—the former by the products of photo-chemical change not disappearing at once, the latter by temporary exhaustion of the visual purple. Edridge-Green[4] has shown that the situation and shape of the positive after-image can be altered by jerking the head, showing that the chemical change is located in the liquid surrounding the rods and cones. Hence these structures must be affected secondarily. The negative after-image is fixed, indicating a situation in the more solid parts of the receptive mechanism.

The adaptation of the retina to various degrees of illumination—an important fact in daily life—is probably due to a change in the position of the pseudo-equilibrium which results from the fact that the products of a reversible photo-chemical reaction are continually recombining during the illumination itself. The circumstance that this adaptation is not a very rapid process is of importance in relation to the practical aspect of artificial illumination, and shows that sudden changes in the lighting of neighbouring objects are not desirable. The suggestion that the ratio of brightness of objects to which the eye turns should not exceed 1 : 100 seems a reasonable one.

The problem of "glare" is also connected, although the fact of the unpleasant and injurious effect of powerful local stimulation of the retina has also to be taken into account. But, like so many of the practical problems we meet with, it requires much more investigation, and the co-operation of the physiologist, the illuminating engineer, the oculist, and the factory inspector is much to be desired.

The effect of lateral illumination brings up the question of the function of the rods as distinct from that of the cones, as do also vision under weak illumination and that known as "night-blindness." The first problem has been very able treated by Dr. Herbert Parsons in a Home Office report, while the enormous range of intensity of the light perceived has been emphasised by Mr. Trotter. This degree of "adaptation" is much greater than could be accounted for by varying apertures of the pupil.

The question of the colour of the light in relation

[3] V. Henri et J. Larguier des Bancels, *Journ. de Physiol. et Pathol.* ol. xiii., pp. 841–56 (1911).

[4] *Journ. of Physiol.*, vol. xlv., p. 70.

to fatigue has been brought to my notice. According to Ferree's observations, either a yellow or a blue tint is more fatiguing than a white light. The difficulty of a satisfactory test for fatigue of the visual mechanism arises here, and we have to deal with a very complicated set of factors. Many of the tests used seem to indicate muscular fatigue either of the extrinsic eye muscles or of the mechanism of accommodation. Moreover, the large question of general fatigue is involved. Tests such as those used by Dr. Stanley Kent would give valuable information as to the effects of various systems of illumination, and especially as to what are to be regarded as defective. It may be pointed out that the present conditions are unusually favourable to investigations of this kind in factories under Government control. An equally important series of questions has been raised by Mr. Gaster, namely, the effect on school children with normal and with imperfect vision of working in adequate light. Data on all these points would be of great value.

Whatever may be the precise results obtained from such investigations, there can be no doubt that children should not be compelled to do their home-work in bad lighting conditions, however necessary it may be to effect a saving in the consumption of gas and electric current. A more widely spread diffusion of information as to ways in which saving may be effected without injurious results is much to be desired.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A memorandum emphasising the urgency of making formal provision for the encouragement of the study of geodesy and geodynamics in the University, and recommending the early establishment of a readership in these subjects if a suitable endowment can be obtained, has been submitted by the Special Board for Mathematics to the General Board of Studies. The latter has reported that it fully concurs in the importance of the early establishment of such a readership. In its memorandum the Special Board gives reasons why special provision and formal recognition for geodesy and geodynamics is particularly called for at the present time in the University. The progress on the theoretical side of the science of the figure of the earth has been promoted in the past very largely by investigators belonging to Cambridge in connection with the scientific problems presented both by the British and by the Indian Surveys, trigonometrical and gravitational. More recently the interconnection of the Surveys of different nations has made the subject an international one, and for the last twenty years the headquarters of the International Geodetic Association, supported by subventions from the various Governments, has been at Potsdam. Reconstruction is called for in the near future, and this country ought to be in a position to resume a large share in the direction. The establishment of a British Imperial Geodetic Institute, with State endowment, is now being urged by responsible scientific bodies, and some institution of the kind will be necessary. Whatever arrangements may be made on the technical and administrative side, the theoretical side, which is the foundation of all progress, is a subject of pure mathematical and dynamical science, and can best be advanced by the universities. In order for Cambridge to retain her historical position in the advance of this important science, and to take part in the training of the men who will be required for its prosecution, some special provision and formal recognition for the subject are called for under modern conditions.

OXFORD.—On June 8 a numerous company assembled in the Sheldonian Theatre to hear Mr. Asquith deliver his Romanes lecture on the Victorian age. The chair was occupied by Lord Curzon of Kedleston, Chancellor of the University, who took occasion to denounce "the gross and gratuitous defamation of the character of our public men." Mr. Asquith, after speaking of the financial and commercial activity which formed one of the chief characteristics of the Victorian age, and the prominence of the novel among the literary productions of the time, went on to offer a brief appreciation of the most famous names in the period under review. Towards the end of his discourse he touched upon the great scientific movements initiated by Victorian chemists, physicists, and biologists, selecting for special mention Faraday, Kelvin, and Darwin. Disclaiming all qualification to speak as an expert, or to hold the balance between antagonistic views as to the method of evolution, he nevertheless paid tribute to the spirit of single-minded investigation manifested by Darwin and to the unselfish and generous manner in which Wallace had minimised his own merits as a co-discoverer with Darwin of the principle of natural selection. The celebrated retort by Huxley upon the ill-judged attack of Bishop Wilberforce was once more related before an Oxford audience, and Mr. Asquith ended by declaring his own conviction that, whatever man's physical pedigree, he had reached a stage in development which raised him into an essentially different category from that of other living beings, and endowed him with qualities which could only be appreciated and expressed by "the poet who had the gift of vision."

On June 11, the anniversary of the burial of Roger Bacon within the precincts of the Grey Friars at Oxford, the first visitation took place of the memorial tablet which was affixed to the city wall in October, 1917.

MR. P. L. BERNSTEIN, of the Municipal College of Technology, Manchester, has been appointed lecturer in electrical engineering at the Hull Technical College.

A HOLIDAY course in psychology, arranged for teachers and others, is to be held at Bedford College for Women, Regent's Park, from August 1 to 10 inclusive. It will include lectures on psychological topics, and afford opportunities for individual laboratory work. Particulars are obtainable from the Principal of the College.

Two Chadwick public lectures on "Our Fisheries and the Food Supply" will be delivered in London by Prof. D'Arcy Wentworth Thompson on June 21 and 28, at 5 p.m. The first lecture, on "The Catch by Line and Trawl," will be given at the Mansion House, and the second, on "The Catch by Net, or the Great Herring Fishery," at the Surveyors' Institution, Westminster. Admission will be free. Further particulars of these and other Chadwick public lectures may be obtained of the Secretary at the offices of the Trust, 40 (6th) Queen Anne's Chambers, Westminster.

THE serious shortage in the supply of teachers for elementary schools is again dealt with in the Report of the Board of Education for the year 1916–17 (Cd. 9045), which is now available. The total number of boys and girls beginning in 1917 to train for the career of teaching was 6158, as compared with 6544 in 1916, and 9614 in 1908. From 1908 there was a steady decline down to 1912 in the number of entrants, when it had fallen to 5232. This was followed by a period of recovery, the number reaching 7047 in 1915, since which date it has steadily fallen again. The immediate cause of the decline which has again set in is to be looked for in the war, though, as the report points out, the end of the war cannot of itself be expected to remedy the evil. A specially serious feature of the present situation is that the progressive decline now going on comes at the end of a series of years, during which the number of entrants has been altogether insufficient for the needs of the country. The report states emphatically that there is no hope of meeting this shortage except by a substantial increase in the salaries of adult teachers and by a general improvement in the prospects of the teaching profession. There is little hope at present of securing an increase in the length of the school-life of elementary-school pupils or of reducing the size of classes—two measures of crying importance—because both improvements depend upon an increased supply of teachers.

AN interesting and suggestive address on "A Londoner's Opportunity in Commerce," under the auspices of the Education Committee of the London County Council, was recently delivered in the Kingsway Hall to the students of the educational institutions in London by the Minister of Labour, the Rt. Hon. G. H. Roberts. The address dealt with the much-increased facilities now offered in London for the due education and training of those engaged in commerce, and it appeared that there were now in attendance as many as 100,000 students in fifty-nine senior and ninety-eight junior institutes. The Minister pleaded that full opportunity of a generous education based upon liberal lines should be available for all the children of the nation. Talent was widely diffused, and was centred in no particular stratum of society. The future abides with those peoples whose standard of education, both technical and moral, is of the highest order. The State must devise some means of ensuring that no child is wasted. Scientific training, not only vocational, but to fit the child for his full duties as a citizen, was indispensable if the nation is to be in a position to meet successfully the crucial problems and the severe competition which will inevitably arise at the close of the war. There must be a closer union and identification of interests between employer and employed and of Government departments concerned with the problems of labour and education, since the one reacts upon the other. If this be ensured, along with the diffusion of education amongst all classes of the community, the future of the country will give no cause for anxiety, since the British people, with their great traditions, and keen to exercise their great qualities, need not fear the rivalry of any existing race in the world. Out of the horrible evil which the war has brought in its train some good has at least arisen, since it has awakened our people to the value of education and to the necessity for measures to give it full and fruitful effect.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 30.—Sir J. J. Thomson, president, in the chair.—Prof. J. **Joly**: Method of avoiding collision at sea. The method of avoiding collision at sea now proposed involves the determination of distance between ship and ship at regulated intervals by means of synchronised signals (preferably wireless and submarine). The principle involved is that ships which are advancing so as to collide approach one another with constant velocity, *i.e.* the relative velocity is constant. If they are going to pass clear the relative velocity is not constant, diminishing to nothing when the vessels are at the passing distance, and then changing sign. The paper embodies tables and curves showing the variations of relative velocity for different passing distances. Assuming that a quarter of a sea-mile is distinguishable by the use of synchronised signals, the method appears to be certainly available for a passing distance of half a mile. Mechanical aids towards increasing the trustworthiness of observations and facilitating them are described. The advantages of the method are chiefly that it involves no special inter-communication between ship and ship (other than the regulated synchronised signal supposed to be emitted by all vessels navigating in fog or thick weather), and that the distance separating the vessels is necessarily kept under observation throughout.—Dr. R. A. **Houston**: A statistical survey of colour vision. The colour vision of seventy-nine students was tested by the method of Dr. Edridge-Green's colour-perception spectrometer. Three of the seventy-nine were found to be colour-blind. The number of observers containing a given number of patches was plotted against the latter, and a frequency curve obtained. If the Young-Helmholtz theory is true, this curve should have two maxima, one for normal colour vision and one for dichromatism. The results show, however, that normal colour vision has quite enough "scatter" to explain colour blindness as an outlying portion of itself, and that it is not necessary to assume the existence of a separate maximum. Various points of interest in connection with the observations are discussed, and it is suggested that a more extensive survey made on similar lines at different places might settle definitely once for all the vexed question of colour-vision theory.—Dr. A. E. **Everest**: The production of anthocyanins and anthocyanidins. Part iii. The paper is a continution of the author's previous work, and deals with the mode of formation, in Nature, of the anthocyanin pigments. Available data concerning the co-existence of anthocyans and flavonol derivatives are discussed, and preliminary experiments with a view to the elucidation of the manner in which the anthocyanin pigments are formed in plants are described. For the first time direct chemical evidence is recorded which supports the prevailing view that the anthocyanin pigments are produced in Nature *via* flavonol derivatives, it being shown, with a very considerable degree of certainty, that in the flowers examined (purple-black viola) the anthocyanin pigment exists side by side with a glucoside of the flavonol derivative, from which the anthocyan would be produced by reduction. The isolation, from the purple-black viola (Sutton's "Black Knight") of a pigment identical with Willstätter's violanin, and experiments to show the presence of a myricetin glucoside in the same flower, are described.

Physical Society, May 10.—Prof. C. H. Lees, president, in the chair.—Dr. S. **Chapman**: The times of sudden commencement of magnetic storms. The paper is a discussion from a new view-point of the data, collected by Dr. Bauer, for fifteen magnetic storms. Maunder's work on the recurrence of magnetic storms at intervals equal to the rotation period of the sun suggests that storms are due to some solar agent transmitted along narrow, well-defined streams issuing from and rotating with the sun. This suggests the view that the relative time of commencement of a storm at different stations depends mainly on the orientation of the latter at the time relative to the sun, *i.e.* on the local time at the station. This forms the basis of the classification in the paper.—Dr. H. S. **Allen**: The entropy of a metal. An expression for the entropy of one gram atom of a substance in the solid state has been given by Ratnowsky. In a communication to the Physical Society in 1916 the author gave the correct form of the approximation required for high values of the absolute temperature in terms of Bernoulli's numbers. The data required for testing the formula have been supplied in a recent paper by Lewis and Gibson, who have given values for the entropy of the elements under the condition of constant volume, and also under constant pressure. These values were deduced from observations on the specific heat assuming the truth of the heat theorem of Nernst, that the entropy of every actual substance in the pure state is zero at the absolute zero of temperature. It is found that the formula of Ratnowsky gives values for the entropy of a solid in very close agreement with those obtained by Lewis and Gibson. The hypotheses assumed in the theory of Ratnowsky are discussed, and the conclusion is drawn that these are probably justified as being at least approximately true. —**T. Smith**: Tracing rays through an optical system.

CAMBRIDGE.

Philosophical Society, May 20.—Prof. Marr, president, in the chair.—B. **Sahni**: The branching of the zygopteridean leaf, and its relation to the probable pinna-nature of *Gyropteris sinuosa*, Goeppert. (1) The supposed quadriseriate "pinnæ" of forms like Stauropteris and Metaclepsydropsis are Tertiary raches, the vascular strands of the secondary raches (pinna-trace-bar, Gordon) being completely embedded in the cortex of the primary rachis. All Zygopterideæ, therefore, have a single row of pinnæ on each side of the leaf. (2) This revives the suggestion that *Gyropteris sinuosa*, Goepp., is a free secondary rachis of a form like Metaclepsydropsis. (3) The genus Clepsydropsis should include Ankyropteris, because (*a*) a fossil described in 1915 (Mrs. Osborn, Brit. Assoc. Rep., p. 727) combines the leaf-trace of Clepsydropsis with the stem of Ankyropteris, the leaf-trace in both arising as a closed ring; (*b*) in *C. antiqua*, Ung., also the leaf-trace arose similarly, as shown by a section figured by Bertrand (Progressus, 1912, Fig. 21, p. 228), in which a row of small tracheides connecting the inner ends of the peripheral loops represents those lining the ring before it became clepsydroid by median constriction.—The structure of *Tmesipteris Vieillardi*, Dang. The most primitive (least reduced) of the Psilotales. Specifically distinct from *T. tannensis* in (1) erect terrestrial habit, (2) distinct vascular supply to scale-leaves, (3) medullary xylem in lower part of aerial stem.—Acmopyle, a monotypic New Caledonian Podocarp. Indistinguishable from Podocarpus in habit, vegetative anatomy, drupaceous seed, megaspore membrane, young embryo, male cone, stamen, two-winged pollen, and probably male gametophyte. Chief differences:—(1) Seed nearly erect; (2) epimatium nowhere free from integument, even partaking in formation of micropyle; (3) outer flesh with a continuous tracheal mantle covering the basal two-thirds of the stone.

DUBLIN.

Royal Irish Academy, May 13.—The Most Rev. J. H. Bernard, president, in the chair.—J. A. **McClelland** and J. **Enright**: Some properties of large ions. The paper deals mainly with the determination of certain constants in connection with large ions. One constant, for example, is measured, showing the rate at which small ions are attached to uncharged nuclei so as to form the large ions. The rates of recombination of large ions and of large and small ions are measured, and also the average charge on the large ions.

May 27.—The Most Rev. J. H. Bernard, president, in the chair.—H. C. **Plummer**: The symmetrical optical instrument. Schwarzschild has discussed the third-order errors of a symmetrical optical instrument on the basis of Hamilton's characteristic function. This treatment leads to the desired end by assuming the results of the Gaussian first approximation. In the present paper the order of development is reversed and a self-contained theory is obtained. This has the advantage of greater simplicity and directness, and it also makes clearer the actual degree of approximation, which would concern the development to a still higher order if required. The conditions for this further development are indicated. The aberrations for a mirror system are deduced directly from those for a refracting system.

Royal Dublin Society, May 28.—Prof. J. A. McClelland in the chair.—Dr. W. E. **Adeney** and H. G. **Becker**: The rate of solution of atmospheric nitrogen and oxygen by water. Part i.: The rate of solution by thin films of water. In this communication the authors deal with the question of the rate at which atmospheric nitrogen and oxygen are dissolved by the surface layer of a quiescent body of water, apart from that of the rate at which the same gases after solution pass downwards through the lower layers of the water. A new method of studying the rate of solution of these gases by water, when the latter is exposed to them in thin films, is described and discussed. The method is shown to give accurate and important results.—Dr. G. H. **Pethybridge** and H. A. **Lafferty**: A disease of flax seedlings caused by a species of Colletotrichum and transmitted by infected seed. The disease described was submitted as a form of "yellowing," but has proved to be one of the "damping-off" type. The parasitic fungus is described as a new species under the name of *Colletotrichum linicolom*. Dormant mycelium is present within the epidermis of the seed-coat of affected seeds, and seedling infection occurs from this during or subsequent to germination. Disinfection of the seed with formalin and with hydrogen peroxide gave good results, but did not entirely suppress the disease. Infected seed has been found in samples coming from Japan, Russia, Holland, Ireland, Canada, and the United States of America.

PARIS.

Academy of Sciences, May 27.—M. P. Painlevé in the chair.—G. **Bigourdan**: The astronomical station of the College of Clermont (first period) and the astronomical expedition to Siam. History of work done at this station between 1652 and 1685, and an account of the astronomical expedition to Siam in 1687.—H. **Le Chatelier** and B. **Bogitch**: The use of the Brinell ball for testing construction materials. For cements and silica bricks the method is modified by introducing a thin sheet of foil between the ball and the material under test, the impressions being then measured on the foil. Preliminary experiments with blocks of lead and copper proved that the use of the foil did not modify the diameter of the imprints. Tests with cement, plaster, silica brick, and clay brick showed that the variations from the mean were much less than in the usual crushing test. The fact was brought out that the opposite faces of the same brick often show marked differences in hardness.—C. de la Vallée **Poussin**: The maximum of the modulus of the differential of a trigonometrical expression of limited order and modulus.—M. **Balland**: Wheat substitutes in munition bread. Details of results with seventeen substitutes for wheat in bread are given.—M. Brachet was elected a correspondant for the section of anatomy and zoology in succession to the late M. Francotte.—J. **Martinet**: Syntheses in the α-naphthindol series.—Mme. Karen **Bramson**: The manufacture of paper pulp from dead leaves. The paper pulp required by France in an average year amounts to about one-tenth that obtainable from the dead leaves produced. As by-products 1000 kilograms of leaves would give 200 kilograms of pure charcoal, 30 kilograms of tar, 1 kilogram of crude acetic acid, and 600 grams of acetone.—C. **Galaine** and C. **Houlbert**: The carbonisation and distillation of peat, sawdust, house refuse, and other light organic products. A continuous process of distillation is described with rotary retorts, securing uniformity of carbonisation, with recovery of gas and by-products.—H. **Colin** and Mlle. Y. Trouard **Riolle**: The graft of the sunflower on the Jerusalem artichoke.—F. **Morvillez**: The leaf-trace of the Chrysobalanæ.—A. **Guilliermond**: Mitochondria and vacuolar system.

MELBOURNE.

Royal Society of Victoria, April 11.—Mr. J. A. Kershaw, president, in the chair.—Miss A. **Osborne**: An abnormality of the frog, *Hyla aurea*. Although abnormalities in the arrangement of the anterior veins are fairly common in this genus, a departure from type is more rare in the case of the posterior vessels. In the specimen described there were two right renal portal veins, one connecting with the iliac in the ordinary way, the other—apparently due to longitudinal splitting of the original single vessel—draining the posterior pelvic region, from which there was a rather more developed venous system than is usual.

BOOKS RECEIVED.

Stoichiometry. By Prof. S. Young. Second edition. Pp. xiv+363. (London: Longmans and Co.) 12*s*. 6*d*. net.

Cookery under Rations. By M. M. Mitchell. Pp. 65. (London: Longmans and Co.) 2*s*. net.

A Medical Dictionary. By W. B. Drummond. Pp. ix+625. (London: J. M. Dent and Sons, Ltd.) 10*s*. 6*d*. net.

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. v., No. 1. Cœlenterata. Part i., Actiniaria. By T. A. Stephenson. Pp. 1–68. (London: British Museum (Natural History).) 10*s*.

Essentials of Practical Geography. By B. C. Wallis. Pp. xv+213. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*.

Field Book of Insects. By Prof. F. E. Lutz. Pp. ix+509. (New York and London: G. P. Putnam's Sons.) 12*s*. 6*d*.

The Dispensatory of the United States of America. by Prof. J. P. Remington and others. 20th edition. Pp. cxxii+2010. (Philadelphia and London: J. B. Lippincott Co.) 2*l*. 1*s*. net.

Studies in Electro-Physiology (Animal and Vegetable). By A. E. Baines. Pp. xxix+291. (London: G. Routledge and Sons, Ltd.) 12*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 13.

ROYAL SOCIETY, at 4.30.—Experiments on the Effect of the Vibration of a Stretched Wire forming part of a Closed Electric Circuit: Admiral Sir Henry Jackson.—The Effect of Wind Pressure on the Pitch of Organ Pipes: A. Mallock.—The Diamagnetism of Hydrogen and the Value of the Magneton: Dr. A. E. Oxley.

OPTICAL SOCIETY, at 7.—The Prevention of Filming in Enclosed Optical Instruments: H. S. Ryland.—A Chart for Finding the Number of Lenses in, and Size of, a Block: Horace Lee.—Charts for Assisting in the Selection of Suitable Glasses for Cemented Doublets: T. Smith.

MATHEMATICAL SOCIETY at 5.—Hellinger's Integrals: Prof. E. W. Hobson.—An Assumption in the Theory of Singular Solutions of Ordinary Differential Equations of the First Order: Prof. M. J. M. Hill.—Quartic and Cubic Residuacity Tables: Col. A. J. Cunningham and Th. Gosset.—Lucas's Process applied to Composite Mersenne Numbers: Col. A. J. Cunningham.—The Gaussian Period Numbers and the Conditions that 2 should be a Residue of a 16th or a 32nd Power: Dr. A. E. Western.—The Aberrations of a Symmetrical Optical System: T. W. Chaundy.—The Rotation-groups of the Regular Figures in Four or more Dimensions: T. Lindsay Ince.

FRIDAY, JUNE 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Literal Development of the Motion of the Lunar Perigee: R. Moritz.—William Herschel's Observations of Variable Stars and Stars suspected of Variability.—The Measurement of Time to the Thousandth of a Second: R. A. Sampson.—The Motion in Longitude of the Red Spot on Jupiter: Rev. T. E. R. Phillips.—The Stellar Magnitude Scales of the Astrographic Catalogue. 12th Note; Hyderabad, Perth, Edinburgh, and Cape Magnitudes: H. H. Turner.—An Example of the Determination of a Minute Periodic Variation as Illustrative of the Law of Errors: S. Chapman.—The Pulsation Theory of Cepheid Variables: F. A. Lindemann.—*Probable Papers:* The Proper Motions of the B Stars: Sir F. W. Dyson.—Observations of a New Star in Aquila.—W. H. Steavenson.—The Origin and Energy of Magnetic Storms: Dr. S. Chapman.

PHYSICAL SOCIETY, at 5.—*Discussion:* The Teaching of Physics in Schools: Opener, Sir Oliver J. Lodge.

MALACOLOGICAL SOCIETY, at 7.—Notes on Magilus and Allied Genera: G. B. Sowerby.—Note on an Unpublished Reprint of a Paper by J. W. Brazier, published in the *Sydney Mail* of December 2, 1871: H. O. N. Shaw.—On a Supposed New Genus of Pelecypoda from the Older Tertiaries of Southern Nigeria: R. Bullen Newton.

MONDAY, JUNE 17.

VICTORIA INSTITUTE, at 4.30.—Annual Address. The Future of Education: Prof. D. S. Margoliouth.

TUESDAY, JUNE 18.

ROYAL STATISTICAL SOCIETY, at 5.15.—Annual General Meeting.—Recent Economic Developments in Japan in their Relation to her Trade with the United Kingdom: K. Yamasaki.

MINERALOGICAL SOCIETY, at 5.30.—The Origin of Septaria: W. A. Richardson.—The Composition of the Nickeliferous Iron of the Meteorites of Lodran, Powder Mill Creek, and Holbrook: Dr. G. T. Prior.

WEDNESDAY, JUNE 19.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Lunar Atmospheric Tide at Greenwich, 1854–1917: S. Chapman.—The Audibility of the Gunfire on the Continent at Chignal St. James, near Chelmsford, during 1917: Miller Christy.—Seasonal Variation in the Audibility of Distant Gunfire: F. J. W. Whipple.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Photo-synthetic Processes: Prof. Benjamin Moore.—A New Type of Infusorian, *Arachnidiopsis paradoxa*: E. Penard.—Diatom Ooze from Deep Antarctic Waters: E. Heron-Allen and A. Earland.—Gnats and Gnat Larvæ: J. M. Offord.

THURSDAY, JUNE 20.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Physiological Basis of Thirst: Major W. B. Cannon.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, JUNE 20, 1918.

MASONRY DAMS AND IRRIGATION WORK.

(1) *Engineering for Masonry Dams.* By W. Pitcher Creager. Pp. xi+237. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 11s. 6d. net.

(2) *Irrigation Works Constructed by the United States Government.* By A. Powell Davis. Pp. xvi+413. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 21s. net.

(1) THE engineering term "dam" has a diversity of applications; it may be defined to include any work which has for its object the confinement of water, (*a*) so as to produce a rise in level, (*b*) so as to exclude it from a certain area, and (*c*) so as to repress the natural flow to any desired extent. In Mr. Creager's book the subject is approached almost entirely from the point of view of the adaptation of dams to the formation of reservoirs in schemes of water conservation. The briefest reference is made to weirs, anicuts, and the like, in river rectification operations, and none to dykes and embankments in coastal defence works. The general location of the dam is assumed to be already determined, and the opening chapter deals with the selection of the most suitable site for the former within the prescribed area. As might be anticipated, the volume is largely a reflection of American practice, with some few illustrations selected from other countries; we miss, however, any reference to English and French designs, some of which are certainly worthy of note.

Within the purview chosen the treatment is lucid and coherent. We confess to a dislike of the use of numerals as points of reference in a diagram, when the lines and areas they indicate have numerical coefficients assigned to them: there is always some possibility of confusion. But this is a minor defect. Dams are divided into six classes, of which only three come strictly within the term "masonry dam." The author investigates in careful detail the various external and internal forces acting upon such structures. The customary preliminary assumptions are made that the dam is rigid and homogeneous, that the foundation is elastic, and that the distribution of basal pressure follows a law of uniform variation. These assumptions are, of course, not strictly correct, but Sir John Ottley and Dr. Brightmore have shown that calculations based on them give results which, at any rate, are not less than the stresses actually experienced, and that they constitute, therefore, a conveniently safe working hypothesis. Indeed, in the present state of our knowledge no other premises are practicable, and the long-continued stability of existing dams demonstrates the trustworthiness of the principles which have been adopted in their design. It is true that Mr. Atcherley, in his theory of tension in vertical planes, has attacked the soundness of the position, but the weight of evidence is undoubtedly against him. The author notes the controversy briefly, but, in view of the vital importance of the matter, we venture to think that the refutation of Mr. Atcherley's contention (ably maintained as it was by Prof. Karl Pearson) by the experimental investigations of Ottley and Brightmore, and also by those of Messrs. Wilson and Gore, is deserving of rather more than passing allusion in a footnote. If the postulates, however, be conceded, the rest of the reasoning follows. The author lays down six rules which govern the design of masonry dams in all essential respects. Each of these rules is then expressed in the form of a mathematical equation, belonging to one or other of two classes, which are termed respectively equations of determination and equations of investigation. The former of these fix the length and location of successive joints; the latter decide whether the results so obtained are compatible with the proportions adopted for adjacent sections and the design as a whole, the process being, to a large extent, one of "trial and error." Following this, a series of examples is worked out in numerical and graphical detail, including two solid non-overflow dams, a solid spillway dam, and two hollow (reinforced concrete) dams. Arched dams are also treated and illustrated, but we are a little surprised at the absence of any comment on the Bear Valley Dam in California, which is remarkable for its extremely slender proportions; if we mistake not, the line of theoretical pressure, reservoir full, lies almost entirely outside the profile.

Some observations on noteworthy instances of failure—at Bouzy and Habra, for example—would have been serviceable, and the expenditure side of the question certainly deserves consideration; but no particulars of cost are given. Taking it as a whole, however, the work will undoubtedly prove a useful text-book for students and draughtsmen, and we desire to express every appreciation of it as such; but it will scarcely be claimed by the author that he has exhausted the subject.

(2) In quite a number of respects, Mr. Davis's volume is complementary to that of Mr. Creager. He gives a series of articles on reservoir work carried out in the United States, including descriptions of the dams, with detailed statements of cost. Some of these dams are discussed and illustrated by Mr. Creager, but Mr. Davis's presentment is less theoretical and more practical, and his range is more extensive, since he includes timber and earth, as well as masonry structures. At the same time, his survey is limited to irrigation works undertaken by the Reclamation Service of the United States Government. The book is an appropriate record of a great State enterprise which has resulted in the provision of reservoirs and distributing systems whereby water is available for the irrigation of nearly two million

acres of land. In the year 1916 the annual product of the acreage actually under treatment was estimated at more than 22,000,000 dollars. The contents of the book are deserving of careful study by engineers and others engaged in the development of irrigation schemes.

BRYSSON CUNNINGHAM.

MEDICAL ELECTRICITY.

Medical Electricity: A Practical Handbook for Students and Practitioners. By Dr. H. Lewis Jones. Seventh edition, revised and edited by Dr. Lullum Wood Bathurst. Pp. xv + 588. (London: H. K. Lewis and Co., Ltd., 1918.) Price 15s. net.

DR. LEWIS JONES was chiefly responsible for raising medical electricity to its present honourable position. He rescued it from the depths of disrepute into which it had been thrust by the hands of charlatans. The best years of his life were devoted to this work; by painstaking study he sifted the real from the sham, and by original investigation and patient experiment introduced many new features in well-known electrical procedures. He showed a readiness to adopt new methods of treatment once he had convinced himself of their value. It was owing to the influence of Prof. Leduc, of whom he spoke in terms of affection and admiration almost verging upon reverence, that he first realised the great possibilities of ionic medication.

On the death of Dr. Lewis Jones the question arose whether the book that epitomised the history of medical electricity should be allowed to pass out of existence. If not, where was the champion who would rescue it and keep alive the name of its creator? Dr. L. W. Bathurst answered the appeal. We may say at once that in the new (seventh) edition, which he has revised and edited, he has carried out his difficult task in a worthy spirit. All the essential features of the book, as we know it, have been retained, and such new matter has been added as the experience of recent months has shown to be worthy of adoption.

Dr. Lewis Jones foretold the further expansion of ionic medication and the use of the thermal effects of electricity. Diathermy apparatus is now fully established in surgical practice as a means of coagulating the tissues. The introduction of drugs through the skin from electrodes moistened with them (ionic medication) is becoming more and more recognised as a valuable medical procedure. The drugs mostly used are the chlorides of sodium, ammonium, and lithium, salicylate of soda, sulphate of zinc, the iodides of potassium and lithium, quinine sulphate, and cocaine hydrochloride. Condenser discharges were first introduced into this country by Dr. Lewis Jones as a good diagnostic method of testing for the reaction of degeneration in diseases of the nervous system. These discharges are capable of accurate quantitative adjustment, and their use as stimuli for nerve and muscle gives more trustworthy results than are obtained by the galvanic battery. The methods of using the condenser discharges for treatment are described in detail.

Prof. Leduc's remarkable experiments on the production of "electric sleep" by rapidly interrupted currents passed longitudinally through the nerve-centres are described. "The anode was placed on the hinder part of the back of a dog, or a rabbit, and the kathode on the skull. The skin was previously shaved. The current was increased gradually, and at a certain strength the animal became unconscious. When this stage was reached, a state of tranquil sleep was induced, in which the animal remained until the current was stopped. During this period of sleep there was anæsthesia. As soon as the current ceased, the animal jumped up and seemed quite well, and no injurious results followed." In the experiment of which Prof. Leduc had the courage to make himself the subject "the current was not pushed to complete insensibility, the operators believing that this had been attained, although the professor was able to tell them afterwards that consciousness had not been lost, though he was quite unable to communicate with them on account of his peculiar condition, which he compares to that of one in a nightmare, aware of some impending disaster, but unable to move or cry out. The current used in these experiments is the Leduc current (§ 63), with 100 periods a second and with closures of one-thousandth of a second. The application of this electric sleep to practical medical purposes remains untried, but it seems possible that it may one day prove useful."

The subject of death from electric shock is discussed in detail. The action of X-rays and radium in treatment and the subject of X-ray dermatitis come in for reasoned comment, though the scope of the book does not permit of a very full account of this important branch of the subject. Chaps. xi.–xviii. contain classified lists of diseases, with the electric methods of treatment best suited to each disease. Finally, we find a useful appendix containing (1) a table of electro-chemical equivalents, (2) a comprehensive list of the towns of Great Britain and Ireland with particulars of their electric supply, and (3) plates, showing the motor points in the head, neck, and limbs, the areas of distribution of the cutaneous nerves, and the segmental distribution of the sensory nerve-roots.

"Medical Electricity" is a true text-book and a valuable work of reference. A. C. J.

INDUSTRIAL WELFARE AND HEALTH.

Welfare and Housing: A Practical Record of War-time Management. By J. E. Hutton. Pp. viii + 192. (London: Longmans, Green, and Co., 1918.) Price 5s. net.

THE employment to-day in munitions factories of women on work to which they were not previously accustomed, and of men rejected by the Army on account of their inferior physique, has raised in an acute way problems of industrial welfare and health upon which efficiency and output are directly dependent—problems with us in pre-war days, but largely disregarded when labour was plentiful and when the need for its conservation was not so manifest.

An authoritative and informing manual dealing with the whole subject is at the present moment much needed, and Mr. Hutton's book is a useful contribution to the subject; probably he intended it for no more. But it cannot in its present form be regarded as a standard work on the subject. It is curiously uneven. The scope of "Welfare Supervision" is outlined in an early chapter, but only touched upon very inadequately later; the subject of factory medical service—a matter of the utmost importance—is dealt with by another writer, who is allowed but limited space; recreation, which is just receiving much attention, and being thoroughly organised in many industrial centres, is represented only by a few instances from some of the factories of Vickers, Ltd.; while the last chapter, which introduces industrial unrest, and deals with it haphazard by a series of quotations, might have advantageously been omitted, for it openly seeks to drag the peace-making influence of the welfare movement into the unsettled turmoil of economic strife, from which it should be ever guarded.

The six appendices which reproduce from Home Office publications legal and other information do, it is true, give condensed and useful information on many points, but appendices often escape the reader. In fact, we regret that Mr. Hutton did not use all the space he allowed himself for discussing at greater length those branches of the subject with which he is best able to deal—industrial housing, transit, and feeding. The chapters dealing with these subjects are the best, and the information they contain as to how Vickers, Ltd., have dealt with the difficulties they had to face will be turned to, both now and in the future, by others with similar problems to solve. They are undoubtedly of considerable value, but we should like to have learnt more of the workers' point of view—as to whether they take any share in organising and administering, or whether they are just housed and catered for "like dumb-driven cattle." The workers' point of view is too often neglected by those who take a paternal interest in them, and there is a tendency to forget that (using Dr. Renton's words) "there is an inseparable relationship in varying degrees between all work and health and disease, and it is only by intimate knowledge of both that a correct conclusion can be reached, especially if, added to this, one has knowledge of the home conditions and habits of the worker."

OUR BOOKSHELF.

Applied Mechanics. Second Year. By H. Aughtie. Pp. 227. (London: G. Routledge and Sons, Ltd., 1918.) Price 2*s*. 6*d*. net.

THIS book opens with a very good discussion on the relations between movement and force; experimental evidence is obtained by use of a trolley and vibrator. Engineers' units are used freely, in which the unit of mass is g pounds. We are rather uncertain, however, as to what exactly the author wishes us to understand by "1 lb. weight." The poundal absolute unit of force is explained, and mention is made of the dyne, but the engineers' metric unit of force of one gram weight or one kilogram weight is not mentioned. There is a slip on p. 11, where, in dealing with momentum, W/g is described as lb., instead of engineers' units of mass. Despite these minor blemishes, this section of the book is a good deal clearer than many similar discussions in other text-books. Some very readable matter on hydrostatics and hydraulic appliances follows, illustrated by appropriate experiments. The chapter on materials will be useful in laboratories possessing but small equipment and under the necessity of using extemporised apparatus. The drawings of apparatus throughout the volume are such as to enable the appliances described to be constructed from them.

Some of the illustrations in the sections of the book dealing with the transmission of motion and power could be improved, especially in the isometric drawings of pulleys and wheels; the distortion in some cases strains the readers' eyes in examining the drawings. The remainder of the book is devoted to the motion of bodies subjected to alternately decreasing and increasing acceleration, motion in a curved path, centrifugal force, and the speed control of engines. The treatment throughout is simple, and the book contains sufficient to interest the student and induce him to push on to the study of the higher branches of the subject.

Glossary and Notes on Vertebrate Palaeontology. By S. A. Pelly. Pp. ix+113. (London: Methuen and Co., Ltd., 1918.) Price 5*s*. net.

IN this little book Mr. Pelly has made a praiseworthy effort to help the inexperienced reader of works on fossil backboned animals and the visitor to museums. It is a laborious compilation, suggested by many visits to the British Museum (Nat. Hist.), and consists of a series of brief memoranda, often quotations, arranged under the names of various extinct animals in alphabetical order. Some of the notes are apt and excellent, but most of them are so inadequate and so lacking in essentials that it is difficult to understand to what type of student they can be of service. A special feature is made of the derivation of each technical name, and in most cases the original Greek words are rightly chosen, but the English equivalents given are not always appropriate to the occasion. There are, however, unfortunate instances of bad guesses (such as those under Goniopholis, Tremataspis, and Uronemus), and the author would have done well to consult the old glossaries of Owen, Page, and Nicholson, which he appears to have overlooked. The book is well edited and remarkably free from misprints, and of a convenient size for the pocket.

A. S. W.

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 Food of the Rook.

Is there not even a fallacy in the argument against this bird which is supported by a note in NATURE of June 6, p. 271? You say that because 52 per cent. of the rook's food is injurious, 19·5 per cent. neutral, and 28·5 per cent. beneficial, therefore "it is impossible to ignore the fact that at present this bird does considerably more harm than good," even though, as you admit, 23·9 per cent. of the rook's food consists of injurious insects.

Is it not possible that if these injurious insects—they doubtless consist of many species—had been left unconsumed by the rook, they might have so multiplied that their total depredation upon man's food supply would have considerably exceeded the 52 per cent. of foodstuffs which the bird consumes directly?

As a method more likely to restore the balance of Nature than the indiscriminate destruction of certain species of birds, the rook included, I would suggest a strict preservation of all our birds of prey; and now that game-preservation has to take second place to food production, this would seem to be a matter for practical legislation. SYDNEY H. LONG.

Norwich, June 10.

IF Dr. Long assumes that the 23·9 per cent. of injurious insects left unconsumed might have multiplied, it is surely only fair that he should also assume that, under similar conditions, the 48·5 per cent. of cereals, potatoes, and roots would have multiplied and brought forth a hundredfold. The point at issue, however, is whether, in estimating by the volumetric method the amount of food consumed by the rook per annum the figures express equivalent or economic values. This method has so long been recognised as the only trustworthy one that it is not necessary to reassert its superiority over all others; and as McAtee has so pertinently remarked (*The Auk*, 1912, p. 452), such "criticisms are wide of the mark, for no one claims that percentages do express economic values. They are simply convenient handles to facts, and they must be interpreted." As the result of long experience and the examination of the alimentary system of upwards of two thousand rooks, by which we have obtained the percentages referred to, viz. that of the food consumed by the rook during a whole year, 52 per cent. is injurious, 19·5 per cent. neutral, and 28·5 per cent. beneficial, our interpretation of these figures, in the light of a long experience as to the detailed nature of the food under each heading, leads us to the conclusion that this bird does considerably more harm than good.

The advisability of practical legislation for the strict preservation of birds of prey and the relationship of such to game-bird preservation is a very complicated subject. All statistics, however, go to prove that the preservation of game-birds is beneficial rather than inimical to food production, and there are many other sides of the question which Dr. Long does not seem to have considered. THE WRITER OF THE NOTE.

A Proof that any Aggregate can be Well-ordered.

IN my letter printed in NATURE for April 4, 1918 (vol. ci., p. 84), the class of direct continuations used for well-ordering should have been stated to be "complete"—that is, to say, no chain of M outside the class is such that every member of this class is a segment of this new chain. The actual construction of a complete class of direct continuations can be carried out in a perfectly unique manner throughout in terms of the possible chains of M, without assuming that there is any chain of M that exhausts M itself. This construction is given in detail in a paper which will shortly appear in the *Comptes rendus*, and the detail of the consequences of the existence thus proved has already appeared in the *Comptes rendus* for April 2.

PHILIP E. B. JOURDAIN.

The Bourne, Basingbourne Road,
Fleet, Hants, May 31.

Construction for an Approximate Quadrature of the Circle.

THE construction for squaring the circle given by Mr. R. E. Baynes in NATURE for June 6 was described more fully by Mr. T. M. P. Hughes in the issue for April 2, 1914, with a simple extension to the representation of the circumference.

Mr. Hughes suggested the use of a permanent set-square of the proper angle, and it seems that the method was known earlier, for in the Science Museum at South Kensington I have seen a set-square for the purpose. I did not examine it carefully, but I believe it bore the inscription "Edward Bing, Riga, 1876." Perhaps someone else may know the history of this instrument and method. GLENNY SMEAL.

University of Edinburgh, June 8.

THERE are in the Science Museum three examples of the set-square to which Mr. Smeal refers. They have been here since 1876, in which year they were lent by the inventor, Edward Bing, a member of the staff of the Waggon Works at Riga, for exhibition in the Special Loan Collection of Scientific Apparatus. There is a short description in the third edition of the catalogue of that collection, published in 1876, at p. 14, and I have no record of any earlier published description. One of the examples is of steel and the other two of wood, the hypotenuse in each case being about 7⅜ in. long. The inventor's MS. label inside the mahogany case containing the steel set-square reads:—"Bing's Circular Square. Kreiswinkel. Equerre circulaire. Cosinus $\alpha = \sqrt{\pi/4}$ ($\alpha = 27^\circ\ 35'\ 49{\cdot}636''$)." DAVID BAXANDALL.

The Science Museum,
South Kensington, June 13.

INTER-ALLIED SCIENTIFIC FOOD COMMISSION.

IN a recent speech Mr. Clynes stated that the events of the last two years had revealed the necessity, not only of securing complete unity of action among the Allies, but also of basing any such action on the guiding principles laid down by science. This recognition of the fundamental part which science should play in the successful direction of public affairs is noteworthy as coming from a member of the youngest of our political parties, and augurs well for the future of the country when this party comes to be entrusted with a responsibility commensurate with its political power. In fact, much of the success of the Ministry with which Mr. Clynes is connected may be ascribed to the adoption by Lord Rhondda of a policy based on the collective experience of scientific men rather than on the political exigencies of the moment. Thus the United Kingdom, alone among the European Allies, has been able to maintain a distribution of bread free from any restriction, at a time when all the others felt themselves constrained to limit the consumption of this, the most essential of all foods, by a system of rationing. This policy does not mean, as is so often thought, that the shortage of breadstuffs in this country was less than that of the other Allies. But Lord Rhondda adopted the scientific policy of economising cereals at the expense of animals, instead of the more obvious expedient of diminishing directly the supply of bread to man.

When the pooling of supplies was decided upon by the Allies meeting in conference, a satisfactory distribution was found practically impossible in the absence of precise knowledge both as to the resources and as to the needs of each nation. The needs of a country depend on physiological facts, and can be deduced from a knowledge of the nutritional requirements of its inhabitants of varying age and sex, and the distribution of these classes of individuals among the population. The question is, therefore, fundamentally a physiological one. The resources of a country can be gathered from the statistical information at the disposal of the Government with regard to agricultural production and trade returns, etc., but the value of these resources as human food is also a question which can be determined only by physiologists. On this account, the Inter-Allied Congress, sitting at Versailles in the autumn of 1917, decided to establish an Inter-Allied Scientific Food Commission, consisting of two representatives of each of the Allied countries, France, Italy, the United Kingdom, and the United States, which should perform towards the Allies as a whole somewhat similar functions to those which had been discharged for the United Kingdom by the Food Committee of the Royal Society. The task of this Commission was, therefore, to examine the resources of each of the Allied countries, to make a forecast of their production for the year 1918–19, and to report on the imports which should be allotted to each country in order that it should be supplied with sufficient food to maintain its population in health and efficiency.

The Commission has held three meetings—at Paris, Rome, and London. In the first two meetings the Commission was mainly employed in establishing certain principles which should serve as a basis for its recommendations as to the imports necessary to meet the deficit of each country. It was of importance in the first place that all countries should make use of the same units of measurement, and base their calculations of food values on the same sets of figures for calorie value and composition of the chief foodstuffs. Thus it was agreed to use the metric ton as the unit of weight, the hectare as the unit of area. A list of the average calorie values of foods, based chiefly on the results of Atwater, was drawn up for use by all Allied countries. As regards the food requirements of the 'average man,' and the relation thereto of women and children of various ages, the Commission accepted the figures given by Lusk. Uniform milling values were arranged, and all countries accepted the principle that the maximum possible amount of cereals, with the exception of oats, should be assigned to human food. It was also agreed that, whereas it is impossible to fix any minimum requirement for meat, it is desirable that the ration of fat should at no time fall below 75 grams per 'average man' per day. The question of a minimum protein ration presented no difficulty, since a sufficient amount of this foodstuff is contained in a mixed diet of adequate calorie value. The Commission thus accepted Bayliss's dictum: "Take care of the calories and the protein will take care of itself." The Commission also laid down the form in which the statistics of production in pre-war years and the forecast of production in the coming year should be presented by each delegation from information supplied by its Government.

We understand that the examination of these balance-sheets for each country has been the work of the Commission during its meeting in London, which has just terminated, and that the Commission will shortly present to the Allied Governments for the use of the Inter-Allied Executives, on whom devolves the task of procuring and apportioning the foods available for import from abroad, a report in which is laid down the relative share in these imports due to each Allied country. It must not be imagined, however, that it is the office of such a scientific commission to effect a rigorous subdivision of the hundred-and-one articles which may enter the Allied countries as food. All it can do is to indicate the principles of such a division and the limits within which it must be carried out. The total food to be imported will be given by the number of food calories due to each country. Some indication as to the distribution of these calories among staple foods, such as meat and cereals, is afforded by the agreement that 75 grams of fat per day should be provided in each country for every 'average man.' In this way a rough subdivision of imports is achieved, but the final division must be left to the Executives, who will be guided by the three controlling factors, viz. supplies, tonnage, and finance.

But this, after all, is the proper limitation of the function of science in public affairs. Science should be the eyes, the informative organ of the State, rather than the organ of volition. The responsibility of action lies with the administration, but the success of the measures adopted will be in direct proportion to the degree in which they are based on the broad principles taught by the body of human experience, which is science.

THE members of the Inter-Allied Scientific Food Commission are as follows:—*France*, Profs. Gley and Langlois; *Italy*, Profs. Bottazzi and Pagliani; *Belgium*, Prof. Rulot; *United States*, Profs. Chittenden and Lusk; *United Kingdom*, Profs. E. H. Starling and T. B. Wood. The conclusions agreed upon by the Commission are summarised in the following paragraphs:—

(1) The Commission has decided to state the weights of the various foods produced in each Allied country in metric tons.

(2) The Commission has decided that it is not desirable to fix a minimum meat ration in view of the fact that no absolute physiological need exists for meat, since the proteins of meat can be replaced by proteins of animal origin, such as those contained in milk, cheese, and eggs, as well as by proteins of vegetable origin. The Commission, on the other hand, resolved to fix a desirable minimum ration of fat. This desirable minimum ration amounts to 75 grams per average man per day. The ration will be made up of (i) fats of vegetable origin and (ii) fats of animal origin. If the amount of fats of vegetable origin is insufficient for this purpose, it may be necessary to maintain a certain stock of animals to furnish a sufficient quantity.

(3) The Commission has established the "man value," *i.e.* the number of average men equivalent to the population of each of the Allied countries. This man value is taken as the basis for calculating the exact amount of food which must be provided for the adequate nourishment of the total population of each country.

(4) The Commission has considered estimates in tons of the home productions of the soil furnished by each Allied country for the year 1918–19. These statistics will serve as a basis for determining the amount of food available for men and for animals respectively in each country.

(5) The Commission recommends that each delegation, in calculating the amount of calories available for men, should assign to men the maximum possible proportion of all cereals except oats.

(6) The Commission is of opinion that a uniform average milling extraction of 85 per cent. for wheat be adopted throughout the Allied countries. It is recognised that this extraction may vary from 80 per cent. in summer to 90 per cent. in winter, and that it can apply to the United States only as regards their internal consumption, and then only in case of scarcity.

(7) The Commission recognises that the methods adopted for reserving the maximum possible proportion of the cereal production for the use of man may vary in each country. Man should always take precedence over animals in the allocation of food by the Governments. If this principle be accepted, the Commission is of opinion that in the fixing of prices it is the prices of animal products which should be limited rather than those of such vegetable products of the soil as may serve equally well for feeding men and animals. Thus the production of veal, pork, and poultry at the expense of food available for man should be discouraged, and this is best achieved by fixing a price for those animal products which will make it unprofitable for the producer to feed the animals on cereals.

(8) The Commission reserves for its next meeting the task of examining the figures which will enable it to determine the calorie value of the home production of each of the Allied countries during the year 1918–19. The determination of this figure compared with the needs in calories of the population of each country will enable the Commission to deduce either the amount of imports necessary for the maintenance of the population or the exportable surplus, as the case may be.

(9) The Commission is of opinion that in all the Allied countries any propaganda having for its object the encouragement of food production and of economy in the use of food should be organised and directed by men of science well acquainted with these subjects.

THE NEW STAR IN AQUILA.

CONTINUED observations appear to indicate that the new star in Aquila is following the normal course of such objects, as exemplified especially by Nova Persei (1901) and Nova Geminorum (1912). The increase of brightness from about magnitude 0·9 at the time of discovery on June 8 to a brightness equal to, or greater than, that of Vega (0·1 m.) on June 9 was succeeded by a steady decline, so that on June 16 the star was reduced to about second magnitude. Nova Persei showed a closely similar rate of fading, from near magnitude 0 on February 23 to magnitude 2 on March 2, and if this precedent be followed, Nova Aquilæ may be expected to reach the third magnitude about June 21, and the fourth magnitude about ten days later. Small oscillations, however, may possibly accompany the general decline.

The spectrum of the nova also appears to have followed the expected sequence of changes, so far as can be gathered from the brief reports presented at the meeting of the Royal Astronomical Society on June 14 by the Astronomer Royal, Mr. Harold Thomson, and Prof. Fowler on the visible spectrum, and by Prof. Newall, Father Cortie, and the Rev. T. E. R. Phillips on the photographic spectrum. The spectroscopic observations may be conveniently summarised by comparison with previous novæ, as discussed by Sir Norman Lockyer in a memoir on the phenomena of new stars published by the Solar Physics Committee in 1914. It is there shown that there are four distinct stages in the history of a nova as revealed by its spectrum: (1) A stage of short duration in which the spectrum is continuous, or continuous with dark lines, occurring during the rise to maximum brightness. (2) The bright-line, or "typical nova," stage, where the outstanding feature is a spectrum crossed by broad bright bands, many of which are accompanied by absorption bands on their more refrangible edges; the brightest lines are those of hydrogen, but enhanced lines of iron are also prominent. (3) A stage marked by the presence of a bright band of unknown origin about λ 4640, which is sometimes the brightest in the whole spectrum. (4) The nebular stage, characterised by the bright lines of gaseous nebulæ, of which 5007 and 4959 are the brightest in the visible spectrum.

The first stage was shown in Nova Aquilæ by observations immediately after the discovery, and in observations by Prof. Newall and Mr. Thomson on June 9. It is especially fortunate that the latter part of this transient stage was caught by Father Cortie in a photograph taken at Stonyhurst on June 10, in which dark lines, somewhat resembling those of Procyon, are the chief feature in the blue and violet parts of the spectrum, although bright lines in the visible spectrum were noted on the same evening by other observers.

The second, or "typical nova," stage had become well developed by June 11, as shown by both the visual and photographic observations. The Cambridge photographs of June 13 are particularly valuable in having α Cygni as a comparison spectrum, thereby confirming Sir Norman Lockyer's conclusion that many of the enhanced lines which are so prominent in this star are reproduced as bright lines in the spectra of novæ. Later observations communicated to us by Prof. Fowler show that this stage continued up to June 16, when his last observations were made. The bright C and F lines of hydrogen, and the enhanced lines of iron $\lambda\lambda$ 517, 502, and 492, have remained the most conspicuous features of the visible spectrum since bright lines appeared, and the diminishing luminosity of the star has been accompanied by a marked reduction in the intensity of the continuous spectrum.

On June 12 it was found that the bright fringe on the red side of the dark band about λ 589 had become a definite bright band, having a narrow dark line near its red edge, the whole group being probably identical with that shown in photographs of Nova Persei taken at the Yerkes and Lick Observatories, which clearly proved that the narrow line was sodium D. Revised estimates of the two bright lines between C and D suggested identity with lines about λ 615 and λ 625 shown in the Yerkes photographs of Nova Persei, and a fainter line was noted about λ 641. Two vague brightenings were also observed between F and G. On June 13 the dark band about D was much reduced in intensity, while that about λ 560 had become considerably stronger. On June 15 and 16 the principal change was the reduced intensity of the continuous spectrum and the consequent greater clearness of the bright lines between 517 and D. If the nova progresses at the same rate as Nova Persei, the third stage may possibly be entered upon about the end of the first week in July.

With reference to the probable distance of the nova, direct determinations of the parallax will necessarily occupy a considerable time. The circumstance that nearly all novæ have occurred in the Milky Way, however, furnishes strong evidence that these objects are actually situated in the Milky Way, and, therefore, at distances of the order of, say, 3000 light-years.

THE NEW SYSTEM OF TIME-KEEPING AT SEA.

AN article in NATURE for April 25 described the new system of time-keeping at sea which was adopted last year by the British, French, and Italian Admiralties. The Board of Trade has now published a memorandum on the subject, with a coloured chart, adapted from a similar one prepared by the "Service hydrographique de la marine française." Reference may also be made to useful explanatory articles by M. J. Renaud in "Annuaire du Bureau des Longitudes, 1918," and in *L'Astronomie* for April, 1918.

The chart illustrates the international time system both by land and sea. The countries and States that have adopted it are coloured either red or blue, red denoting Greenwich time, or time differing from it by an even number of hours, while blue denotes a difference of an odd number of hours. A few countries (India, South Australia, Venezuela) use time differing from Greenwich time by an odd number of half-hours; these are coloured violet on the chart. The remaining countries are coloured yellow. Inspection of the chart shows what great progress the international time system has already made. The whole of Europe except Russia, almost the whole of Africa, Japan, Australia, North America, Peru, and Brazil have adopted it. It is not improbable that its adoption by ships may lead to still further extension of it on land.

It is much to be regretted that the Board of Trade uses the term "zones" to denote the regions that keep the same time. The use of this term ought to be confined to the designation of belts parallel to the equator, not at right angles to it. It is much better to employ the term "fuseau," which the French have adopted, unless a suitable English name can be devised.

Inspection of the chart shows that the boundaries of the "fuseaux" on land do not strictly follow the theoretical meridians; they frequently deviate to some political boundary not far away, in order to keep the same time throughout a country or State. It is obviously convenient for a ship while in territorial waters to keep the time observed on the adjacent coast; local tide tables, etc., would be given in this time. But when on the high seas it should change its clocks at the nearest convenient moment to the time of entering the new "fuseau" (say, at the nearest change of watch).

It is important to note that the change of system is wholly in the direction of greater simplicity. Hitherto there have been two entirely distinct sets of timepieces on board: the chronometers, used in navigating the ship, which keep Greenwich time; and the ship's clocks, used for the ordinary purposes of daily life; these have usually kept local apparent time, being set about noon on each day, sometimes twice a day if the ship was travelling very rapidly. For the future all clocks on ships in all parts of the world ought to show the same minute as the gate-clock at Greenwich, the difference being in the hours only.

The French and English have adopted different modes of numbering the "fuseaux." Both agree to call the Greenwich "fuseau" (extending from 7½° W. to 7½° E.) zero; the French number the "fuseaux" to the east of this +1, +2, +3, in succession, up to +23 for the "fuseau" just west of the zero one. These numbers give the correction to apply to Greenwich time to obtain ship's time. The English system uses two series of numbers, each from 1 to 12, negative to the east, and positive to the west, thus giving the correction to apply to ship's time to obtain Greenwich time. It matters little which is done, provided the system is understood. It is recommended that the "fuseau"-number be always displayed on the ship's clocks, and quoted in all time-readings. Only one ambiguity would remain—that of the Greenwich day. Uncertainty about this might arise in the neighbourhood of the antimeridian of Greenwich; the line of demarcation, which is shown on the chart, is not quite regular, different islands keeping Asiatic or American reckoning according to their political affinities and history.

It was with the view of lessening these difficulties that Commandant Vincent added a day-hand to his chronometer dial (see p. 146). It is clear that the difficulty is considerably increased by the fact that at Greenwich two different systems, the civil and the astronomical, are in use, the day beginning at midnight and noon respectively. It is hoped that the reform of using the former system for all purposes may soon be introduced. From the discussion that is now taking place, it is clear that the only serious difficulty that is felt in the matter is the breach that will be caused in the continuity of astronomical records. This inconvenience will be minimised if in all records, for some years before and after the change, the time-origin employed is clearly stated.

Summer time is not to be used at sea; it would cause needless complication, and the reasons which make it desirable on land are much less potent at sea; it will be remembered that navigation and astronomy were excluded from the scope of the Act, and the Greenwich ball has been dropped throughout at 1 o'clock Greenwich time (2 o'clock summer time). A. C. D. CROMMELIN.

DAMASCENE STEEL.

DAMASCENE or Damascus steel made its appearance in Western Europe during the Middle Ages. It was manufactured in India, and the origin of the process may be traced back many centuries B.C. The same kind of steel had previously been introduced into Russia, where it was known as "poulad" or "bulat." The external characteristic of this steel was its patterned surface-watering or "jauher" (Persian), which gave rise to the name "poulad jauherder." It was imported into Russia through Persia and the Caucasus, and into Western Europe through Syria and Palestine.

A most interesting and important study of this material was presented by Col. N. T. Belaiew at the spring meeting of the Iron and Steel Institute. According to his researches, there were three principal methods of producing it:—

(1) The old Indian, by which crucible steel was made by melting pure ore with the best kind of charcoal; (2) the Persian, in which case pure soft iron and graphite were the ingredients; and (3) a particular heat treatment which was in the nature of a prolonged tempering.

The greatest care was taken in regard to the temperature and duration of the melting process, since it was known that the best "watering" could be obtained only with alloys which were kept molten for a long time and afterwards very gradually cooled. The fluid alloy was allowed to freeze in the crucible, and removed only when cold in the form of a cake.

These cakes have been described by Tavernier and others, and were brought to this country by Scott. Numerous investigations were carried out on them, notably by Stodart and Faraday in England, Réaumur and Bréant in France, and Anossoff in Russia. The last-named was led so early as 1831 to apply the microscope to the study of polished and etched surfaces, not merely of these steels, but also of all his alloys that were intended for industrial applications. He was the first to classify the patterns of damascene blades, and showed that in steels containing the least carbon the watering took the form of parallel stripes, and that as the carbon increased these became wavy, then mottled, and finally passed into vertebræ, which were considered the most perfect form. To this the Persians gave the name "kirk narduban," or "forty steps of Mahomet's ladder."

Col. Belaiew took up the experimental study of these steels at the instigation of Prof. Tchernoff, who, in lecturing at the Michael Artillery Academy, Petrograd, stated that "the best kind of steel ever manufactured was undoubtedly the bulat." He found that the majority of damascene steels contained from 1·1 to 1·8 per cent. of carbon. The following is a complete analysis of one of them:—

C	Mn	Si	S	P
1·49	0·08	0·005	0·05	0·10

He then proceeded to reproduce the steels artificially at the Putiloff works, using the Eastern Crucible method (soft iron and graphite), and studied both the primary crystallisation (from the melt) and the secondary (from the solid), and showed that the latter differed in its form according to whether the steels were hypo- or hyper-eutectoid, *i.e.* $<$ or $>$ 0·90 per cent. of carbon. Damascene steels all belong to the latter category. He found that in all cases where the alloys were slowly cooled a remarkably clear primary and secondary crystallisation followed. The former consisted of dendrites of austenite of very varying carbon content, the latter of dendrites of cementite which closely followed the orientation of the austenite axes. The higher the carbon the more closely did the primary and secondary crystallisations resemble one another, and a "structure of large crystals" resulted. To understand how, from an alloy with this structure, the beautiful wavy or motley watering of Oriental blades can be obtained, he discusses the life-history of a 1·5 per cent. carbon steel from the molten state. Every cake is either cut in two, in which case each half makes the blade of a sabre, or the central part is cut away and the remaining ring is cut through at one place so as to facilitate subsequent working and then drawn into a bar. If the specimen is only drawn lengthwise the "veins" produced are longitudinal and the watering consists of parallel stripes or ronces. But if the forging is executed in two or more directions, then, "according to the skill of the workman and the quality of the damask, all the other shades and gradations—the wavy, the motley, and the 'kirk narduban'—may be obtained." This watering, when examined by the naked eye, represents the macrostructure of the finished article and shows the way in which it has been mechanically treated.

The most remarkable quality of these high-carbon steels is their unusually high degree of malleability. Col. Belaiew shows that while the melting process and the slow rate of cooling are to some extent responsible for this, the real explanation is to be found in the microstructure of the finished article, which reveals the fact that the free cementite (hyper-eutectoid) is no longer present in the sharp, pike-like projections characteristic of the metal in the cake, but is in the form of small, rounded globules resolved at about 50 diameters' magnification, which appear like "milky ways." The main cause of the great malleability of damascene steel is the globulitic microstructure of the cementite produced by forging at a low temperature. This "spheroidising," which has been studied in other connections by Howe, occurs readily at temperatures rather below Ac_1 (730° C.), and is much facilitated by forging. All the Oriental writers, and especially Anossoff, insist on the importance of not exceeding a red heat during this operation; and the reason for this is now clear. This aspect of the results of Col. Belaiew's research has a most important lesson for the manufacturers and users of tool-steel. The low-temperature forging below A_1 is a process capable of manifold application to high-carbon steels, which, without it, are too brittle. It is scarcely too much to say that there are many cases where carbon tool-steel treated in this way could be used instead of the much more expensive alloy steels.

H. C. H. C.

NOTES.

SIR WILLIAM CROOKES attained the age of eighty-six on Monday, June 17, and received the congratulations of many friends. He bears the burden of his years lightly, and is still actively engaged in research. This spirit of inquiry has been maintained throughout his life, and we trust that strength will be given to Sir William for some time yet to enable him to continue to satisfy it.

WE regret to announce the death at forty-seven years of age of Dr. E. A. Newell Arber, demonstrator in palæobotany at the University of Cambridge since 1899.

FOLLOWING the precedent of last year, the Conference of Delegates of Corresponding Societies of the British Association will this year be held in London in the rooms of the Geological Society on Thursday, July 4. Dr. F. A. Bather has been nominated as president, and a discussion will be invited upon his address, which will be entitled "The Contribution of Local Societies to Adult Education." The question of afforestation will also be considered.

FROM a statement made by Sir Albert Stanley, President of the Board of Trade, in an address at Manchester on Friday last, June 14, it appears that the Government has decided to take certain further steps in support of the dyes industry. The matter was referred to in a note recently published in these columns (NATURE, May 23), and it is satisfactory to find that, in addition to the control of imports by a system of licences and in order to further financial help to be given among smaller makers, a combination is to be arranged between the two great firms, British Dyes, Ltd., and Messrs. Levinstein, Ltd. The foreigner must be fought with his own weapons, and long ago in Germany it was recognised that mutual support and assistance contributed almost as much as, or perhaps more than, any other condition to the success of the dye-making firms. One of the first things which should now be done in this country is to prepare a general survey of the dye field, to ascertain which firms are best prepared to make particular classes of dyes and their necessary intermediates, to determine in what directions the home industry is weakest, and to pool the results of research. The relation of explosives to the dye-making business must be steadily borne in mind, and the "combine" which is contemplated between Nobel's and other explosive manufacturing concerns is a feature of the situation from which results of the utmost importance may ensue to the dyes industry.

THE death is announced, on June 9, at sixty years of age, of Mr. J. H. Lace, C.I.E., formerly conservator of forests, Burma.

THE Toronto correspondent of the *Times* reports that the Honorary Advisory Council for Scientific Research, which has been studying measures to foster the scientific development of Canadian industries, proposes the establishment of a research institute for the Dominion.

THE third Gustave Canet lecture of the Junior Institution of Engineers will be given on Monday next, June 24, at the Institution of Civil Engineers by Sir Wilfrid Stokes, who will take as his subject "The Stokes Gun." Free tickets of admission may be obtained from the secretary of the Junior Institution of Engineers, 39 Victoria Street, S.W.1.

THE Royal Academy of Science of Turin has announced, we learn from *Science*, a prize of 26,000 lire, to be awarded for the most remarkable and most celebrated work on any of the physical sciences published in the four years ending December 31 next. The prize fund is a bequest from Senator T. Vallauri. Competition is open to Italian and foreign men of science, and the term "physical sciences" is to be taken in the broadest sense.

WE learn from *Science* that the Boston Society of Natural History has awarded the Walker grand honorary prize, which this year takes the form of a one-thousand-dollar Liberty bond, to Prof. Jacques Loeb, of the Rockefeller Institute, New York, in recognition of his many published works covering a wide range of inquiry into the basic concepts of natural history. The Walker grand prize is awarded every five years, under the terms of the will of the late William Johnson Walker, "for such scientific investigation or discovery in natural history," first made known and published in the United States, as the council of the society shall deem deserving thereof.

THE President of the Board of Agriculture and Fisheries has appointed a Committee to consider and report how Government stores which may become available after the close of the war can best be utilised for agricultural and horticultural purposes, and what methods of purchase by farmers and others should be adopted. The members of the Committee are:—Earl Grey, Mr. J. S. Gibbons, Mr. W. R. Hopkinson, Prof. F. Keeble, Mr. Douglas Newton, Mr. J. W. B. Pease, Capt. Sir Beville Stanier, Bart., Mr. R. Stephenson, Mr. N. Walker, and Major the Hon. E. F. L. Wood. The secretary of the Committee is Mr. E. G. Haygarth Brown, of the Board of Agriculture and Fisheries, 4 Whitehall Place, S.W.1.

THE possibility of exploration in the Himalaya by aeroplanes is discussed by Dr. A. M. Kellas in the *Geographical Journal* for June (vol. li., No 6). Dr. Kellas believes that there should be no physiological difficulty in flying for some time at an elevation of 25,000 ft. provided oxygen and a suitable apparatus for utilising it were carried. October and November, or, better still, September and May, he considers the best months as regards climatic conditions, but the problem of flying through cloud would have to be solved. Another great difficulty would be landing and starting at great altitudes. The snow at such altitudes is either powdery, or soft beneath a thin hard layer, and would therefore require either rolling or compressing with a heavy stamp to make it firm enough to give the necessary resistance to a moving plane. Dr. Kellas thinks the airmen would have to be acclimatised to high altitudes by many trial flights. In the discussion which followed the paper a number of airmen took part, and their general consensus of opinion seemed to be opposed to the project.

IT was reported in the *Times* of June 12 that British iron and steel manufacturers have taken an important step for securing the future position of their industry, and that they have agreed to form a national council on trade policy. This council is to be representative not only of the iron and steel capitalists, but probably also of the employees. Undoubtedly it would be wise to constitute the new body on this basis, and it would afford another illustration of the effectiveness of the alliance between employers and employed which is coming to be one of the most important results of the war in this country. The function of the council will be to obtain an assured supply of the raw materials of the industry and a proper organisation with regard to production and export. Such a policy has much to commend it. The German iron and steel industry was organised for this purpose for many years before the war, but there was no place for labour in it. A representative conference of masters and men is also said to have agreed to the establishment of a second body, viz. an industrial council to deal with all labour questions in every branch of the iron and steel trade.

BY the death on June 11 of Mr. R. Hooper Pearson, at the age of fifty-two years, horticulture has lost one of its most earnest, capable workers. As managing editor of the *Gardeners' Chronicle* Mr. Pearson exercised a steadying, wholesome influence on the science and practice of an industry, we might say a profession, which in recent years has grown in importance, and in consequence of the war is likely to become one of our principal food-producers. He was a great worker without ostentation. His knowledge of things appertaining to horticulture was exceptional. He had sound judgment and an open mind, and, what was of the greatest value in the position he held, kept steadily to the task of controlling and guiding the art of cultivation along the path that leads to improvement. To those who did not know him intimately he was likely to appear lacking in "push" and "vim," but his habit was to sift and weigh before coming to a decision. This was evident in the journal which he managed with such success. He planned and edited a series of popular handbooks known as "Present-day Gardening," and was the author of the useful "Book of Garden Pests." Mr. Pearson's best work, however, was more personal than books, and his hand will be missed in many channels where he was wont to serve disinterestedly.

THE recently issued annual report of the Decimal Association shows that considerable progress was made during the past year in the movement for the adoption of a decimal coinage and the metric system of weights and measures. The report of the Government Committee on Commercial and Industrial Policy is referred to, and, in explanation of the fact that it does not favour any immediate change, it is pointed out that the Committee appears to have been led to this decision by its anticipation of the exceptional difficulties with which trade will be faced during the period immediately following the war. In a leaflet entitled "Great Britain's Interest in the Metric System of Weights and Measures," which accompanies the association's report, it is maintained that increased competition from our foreign rivals after the war will necessitate the organisation and development of our export trade, and demand the elimination of all hampering influences such as our present weights and measures. The suggestion is put forward that during the transition period it would not be unreasonable for the Government to bear the cost of the reform in certain cases; for instance, by allowing firms to retain out of the amount they would otherwise pay as excess profits a sufficient sum to recoup them for the charges they incur owing to the change.

AFTER the marked failure of wheat all over the world last year, it is pleasant to be able to record that this year's crop promises to be good. According to a leaflet issued by the International Institute of Agriculture, the Argentine Government's estimate of the 1917–18 yield of wheat in the Argentine is 211·3 per cent. higher than last year's crop and 35·8 per cent. higher than the average for the five years 1911–16. New Zealand has issued an amended estimate of the wheat crop in that country, showing an increase of 24·6 per cent. on the 1916–17 yield, but a decrease of 2 per cent. on the five-year average. The total yields of wheat for the southern hemisphere (Argentina, Uruguay, Union of South Africa, Australia, and New Zealand) are estimated at 55·4 per cent. above last year's crop and 34·3 per cent. above the average yield for the five years 1911–16. The total crop of oats in Argentina and New Zealand for 1917–18 is estimated at 123·1 per cent. above last year's crop and 6·5 per cent. above the five-year average. As regards the northern hemisphere, the agricultural situation was an average one in Spain at the beginning of April; in France the weather is generally favourable for the growing crops and for spring sowing. In Great Britain the weather is favourable for all crops, while in Ireland the condition of crops is considered quite satisfactory. It may be stated in summary that on April 1 the condition of crops in the northern hemisphere was excellent in Ireland, good in Great Britain, France, and the United States, and average in Spain, Italy, Switzerland, and Morocco.

WE have recently received a copy of the first number of *Helvetica Chimica Acta*, a new periodical devoted to the advancement of pure chemistry. Before 1914 the contributions to chemical literature emanating from Swiss laboratories had reached a total of, approximately, 380 per annum, but the Swiss Chemical Society has hitherto had no official organ for the publication of these. Whilst the hospitality of foreign scientific journals is duly acknowledged, and notwithstanding that there has been some hesitation about increasing the number of periodicals dealing with chemical questions, it is now considered necessary for the society to have its own journal—and all the more so since the present postal restrictions are hindering the publication in other countries of chemical researches carried out in Switzerland. In the new periodical it is proposed to give accounts of investigations made, both by chemists living in Switzerland and by Swiss chemists who are domiciled abroad, so that the result will represent, as it were, the whole national effort in this branch of scientific inquiry. Papers will be printed in any of the three national languages (French, German, Italian), and there will be six or eight issues a year. The first number opens well with a contribution by A. Werner on a new type of isomerism in cobalt compounds. This is followed by half a dozen other communications, some of which are excellent examples of research work in pure chemistry. The periodical is clearly printed and neatly produced. Chemists in this country will follow the new venture with sympathetic interest.

THE announcement of the death on May 12 of Dr. R. G. Hebb brought a sense of personal loss to a wide circle of scientific colleagues and friends, felt with particular keenness by the fellows of the Royal Microscopical Society, to whom Dr. Hebb had endeared himself by his tact and geniality, no less than by his erudition and intimate acquaintance with things microscopical during the thirty-three years he had been connected with the society. Dr. Hebb was the eldest son of the late John Hebb, of East Dulwich. A graduate in arts and medicine at Cambridge, King's College Hospital shared with the University in fostering that keenness in microscopy which occupied so large a share of his life's work. Pathology, both naked eye and microscopical, early claimed his energies, and he was undoubtedly seen at his best in the post-mortem room or laboratory; but, at the same time, he was a sound clinical teacher, and made his mark in the out-patient department and in the wards of Westminster Hospital, the staff of which he joined in 1888, and where for many years he held the dual posts of physician and physician pathologist. His association with the Royal Microscopical Society was long and intimate. In 1855 Mr. (now Sir) Frank Crisp, at that time its secretary, enlisted his services on the staff of the society's Journal, and from then onwards Dr. Hebb was a regular contributor to the pages of the Journal. He was elected an ordinary fellow of the society in November, 1885, and appointed to the council a few years later. In 1902, on the death of Mr. A. W. Bennett, Dr. Hebb succeeded to the editorship of the society's Journal (the first number for which he was solely responsible being that for April, 1902), a post he continued to hold to the time of his death. In 1892 he became co-secretary with Dallinger, from which time until 1911 he was virtually responsible for the conduct of the society's affairs. After the resignation of Dallinger in 1907, Dr. Hebb became the senior secretary, and had as associate secretaries, first J. W. Gordon, and afterwards F. Shillington Scales. In 1911 he resigned the post of secretary and was elected a vice-president. During the fourteen years he held office Dr. Hebb proved himself an ideal secretary, and the society, which has lost a devoted officer, fully realises the debt it owes to his exertions.

THOUGH Benjamin Franklin at the beginning of the War of Independence seriously considered the possibility of arming the American troops with the longbow, as a cheaper and more effective weapon than the flintlock musket, archery among the Indian tribes is nearly a lost art since the introduction of the rifle. There is little evidence to show how these tribes made and used the bow and arrow. Mr. S. T. Pope induced the last survivor, Ishi, of the Deer Creek Indians of North-Central California, to live at the University of California from 1911 to 1916, and from him a mass of information on the subject was obtained, a summary of which has been published in vol. xiii., No. 3, of the University Publications in American Archæology and Ethnology. The process of making bows and arrows is elaborately described. Ishi's greatest flight-shot was 185 yards, which contrasts badly with that of Ingo Simon in France in 1914, with a very old Turkish composite bow, of 459 yards. The greatest recorded flight with the English longbow was made by I. Rawlins in 1794, a distance of 360 yards. The best American flight-shot is 290 yards, done by L. W. Maxson in 1891.

THE Carnegie Institution of Washington has issued an elaborate monograph by Mr. W. Churchill on "Club Types of Nuclear Polynesia." By "Nuclear" Polynesia, a term proposed by the writer, he means Samoa, as the "nucleus," with Nīnā, Tonga, and Viti on the perimeter. He divides the clubs of this region into various types—the billet, rootstock, missile, pandanus, axe-bit, lipped, mace, coconut-stalk, and others. In each section is provided a full series of measurements and descriptions, with details of specimens in American and other collections. In previous volumes the author has discussed the linguistic evidence, and the present investigation corroborates the theories already arrived at. "In these wooden artifacts of Nuclear Polynesia, highly evolved in form to correspond with needs not only utilitarian, but even vital in their necessity, most remarkably specialised in ornament, there are found with equal clarity the memorials of such transit and sojourn of the peoples of the Nuclear Polynesia race through and in various parts of Melanesia as has already been established through the study of the many languages of the two Pacific areas."

IN the Bulletin of Entomological Research (vol. viii., parts 3–4, 1918) there is a noteworthy paper by Dr. J. J. Simpson on "The Bionomics of Tsetse-flies in the Gold Coast." By marking a large number of flies and liberating them at various distances from the river near which they had been captured it was ascertained that a few returned from a point four miles away, but no large proportion from more than two miles away. As none were found farther from the river than their place of liberation, it seems that these insects are constantly attracted by water. Mr. H. Tetley contributes a paper of value on the mouth-parts of *Pangonia longirostris*, pointing out some marked secondary sexual differences, and drawing comparisons with corresponding structures in other Tabanidæ. It is doubtful if the minute lobe of the maxilla, described by Mr. Tetley as the lacinia, really represents that element of the typical appendage.

IN an interesting memoir on the early development of *Didelphys aurita* (*Quarterly Journal of Microscopical Science*, vol. lxiii., part 1), Prof. J. P. Hill points out a fundamental distinction between the blastocyst of the marsupials (Didelphia) and that of the higher mammals (Monodelphia). In the former the process of segmentation gives rise at once to a hollow blastosphere, the wall of which is composed of a single layer of cells, differentiated into formative and non-formative polar areas. The formative area furnishes both ectoderm and entoderm of the blastocyst; the non-formative is the trophoblastic layer. In the Monodelphia, on the other hand, as is well known, the formative cells always form an inner cell-mass enclosed by the trophoblast. The Ornithodelphia (Monotremata) agree with the marsupials in the arrangement of the formative and non-formative areas, and for the condition exhibited by these two groups Prof. Hill suggests the term "Phanerotypy," the term "Cryptotypy" being proposed for the condition met with in the higher mammals. Precision in terminology is much to be desired, and in this connection we may perhaps point out, without being hypercritical, that the author speaks of four-celled and eight-celled *eggs*. Surely such stages can scarcely be called eggs. Why not call them embryos?

There is no fact with which medical men are more familiar than that the nerve-tracts which connect the brain and body are crossed, the right half of the body being united to the left hemisphere of the cerebrum and the left half to the right hemisphere. In 1907 Prof. A. Francis Dixon, Trinity College, Dublin, sought to explain the crossed arrangement by supposing that it was a result of the primary connection between the right halves of the retinæ with the right hemisphere of the cerebrum. The right halves of the retinæ receive rays coming from the left field of vision—the field in which the left half of the body is situated. Prof. Dixon pointed out that there is a manifest functional advantage in having the part of the brain which controls the movements of a limb situated near the cerebral area which receives the visual field in which the limb is situated. To secure that end, the nerve-paths have to be crossed, so that the hemisphere which receives the left visual field will also control the left half of the body. In the Dublin *Journal of Medical Science* (March, 1918) Prof. Dixon has carried his explanation a stage further—an extension due to the discovery by Col. W. T. Lister and Lt.-Col. Gordon Holmes that the retinal picture is inverted in the visual cortex of the brain, the upper half of the field of vision falling on the lower half of the visual cortex. It is well known that the movements of the body are represented in an inverted order in the cortex of the brain, those for the mouth and face being placed lowest down, and those for the lower limb higher up. If the retinal connections are the circumstances which determine the distribution of cortical areas, as Prof. Dixon supposes, the visual fields being inverted in the cortex of the occipital lobes, then we should expect, just as we actually find to be the case, a corresponding inversion of the motor areas—the movements of those parts of the body which lie in the upper field of vision being lowest down on the surface of the brain, and those in the lower visual field highest up.

The American fuel famine is discussed at length, in the *American Museum Journal* for February, by Prof. C. Berkey and Mr. C. van Hise. The shortage of coal, which is acute, and has demanded drastic legislation, is in no way due, they remark, to any precautionary measures engendered by fear of exhausting the mines, for careful estimates show that at the present rate of consumption, which is enormous, the mines of the United States will continue to yield for something like two thousand years. The scarcity is to be attributed entirely to the unprecedented demands to feed the multifarious industries dependent upon coal and the difficulties of transport. Labour and distribution, in short, are unable to keep pace with the demand. But Prof. Berkey is of opinion that the anthracite reserves are being depleted at a much faster rate than the bituminous coals, and will probably not last more than a hundred years. The rate of production of bituminous coals at the present time in the United States is about 600,000,000 tons per annum.

The problems in the development of British Guiana, a somewhat neglected Possession, are discussed by Sir Walter Egerton in the Journal of the Royal Society of Arts for May 31 and June 7 (vol. lxvi., Nos. 3419 and 3420). Sanitation, drainage schemes, and improvement of the water supply are all required. These, as well as administrative reforms, are discussed by Sir Walter Egerton, but he lays most stress on questions of population and communication. Nearly 50 per cent. of the inhabitants are East Indians, and their numbers are increasing. The prosperity of the sugar industry rests on their labours. Chinese used to come in large numbers many years ago, and proved most useful, but the Chinese population is now small. Sir Walter Egerton insists that interference with the immigration of East Indian and Chinese of both sexes in equal numbers will prevent the due development of the colony. At present the cultivated area of British Guiana is more or less confined to a coastal strip of plains intersected with drainage and irrigation canals. This gives little scope for an increased white population. The interior of the colony, however, is largely rich savannah land, more healthy than the coast, and well adapted for cattle-ranching. There are also great possibilities in gold and diamond mining. These considerations emphasise the second great need of the colony—railway communication with the interior by a line from Georgetown to Rupununi savanna and the Brazilian frontier. At present the only route to the interior is by water, and it is not easy.

The May issue (vol. ii., No. 5) of the quarterly Journal of the Society of Glass Technology contains an important article by Prof. Boswell on British supplies of potash-felspar. A good account is given of all the more important localities where potash felspar, orthoclase or microcline, is known to occur in quantities sufficient to warrant the assumption that it may prove to be of economic importance, the questions of purity of the material, quantity available, ease of access, and convenience of transport being all considered. The author holds definitely that felspar from all the known British localities requires to be hand-picked in order to obtain it in a state of purity sufficient to enable it to be used in glass or pottery manufacture or for the extraction of potash. There are practically seven groups of localities represented, namely, (1) Cornwall, (2) between Lochs Laxford and Inchard, (3) between Durness and Eireboll, (4) near Overscaig, Loch Shin, all the three last-named being situated in Sutherlandshire, (5) Belleek, on the borders of Co. Donegal and Co. Fermanagh, (6) Glenties, in Co. Donegal, and (7) Belmullet, in Co. Mayo. It would appear that the purest felspars are those of Cornwall and Belleek, the deposits being in both cases fairly accessible, but the quantities in both places appear to be limited. The other localities show much larger quantities of mineral, but their potash contents are decidedly lower, and the localities are for the most part inconveniently situated in respect of transport. The author does not appear to think that, as a source of potash, any of these felspar deposits is likely to be economically workable in normal times, but is apparently rather more sanguine as to the prospects of the best of these deposits as a source of supply to the glass and pottery industries.

G. Vallauri, in *Elettrotecnica* for January 25 and February 5 last, discusses at some length the theory of the audion. Included in the article is a summary of the uses of vacuum tubes with three electrodes for radio-telegraphy, their properties and characteristic curves, approximate formulæ for these characteristics, the possibility of investigating the action of the audion as an intensifier and generator, the study of typical methods of connection, and the possibility of investigating the audion as a receiver and in the more complex cases in which it fulfils several functions at the same time.

W. Block, in the *Central-Zeitung für Optik und Mechanik*, January 20, describes a method of photographing shells in flight by a kinematograph camera having a specially broad film. The film moves forward in jerks, the photographs being taken when it is stationary, through a rotating screen having thin slits cut in it. The length of exposure is varied by varying the width of the slits. Since, however, the time between the successive stationary positions of the film is too great in comparison with the rate of motion of the shell, numerous slits are cut in the screen, and several exposures are made on the same portion of the film so as to show the projectile in various stages of progression.

An interesting product of cellulose distillation is described by M. J. Sarasin in the *Compte rendu de la Société de Physique* of Geneva (No. 1, 1918). When cellulose in the form of cotton was distilled under reduced pressure (12 to 15 mm.) a semi-crystalline distillate was obtained, which, after purification by crystallisation from hot water or from acetone, proved to be levoglucosane. This compound is not itself fermentable by yeast, but on hydrolysis with dilute sulphuric acid it is converted into α-glucose, which can be transformed into alcohol by fermentation. The interest of the observation lies in the possibility which it suggests of obtaining the glucose, and thence alcohol, by the distillation of cellulosic raw materials on an industrial scale.

Naturen, the Norwegian popular science monthly, contains in its April issue an illustrated account by J F. Schroeter of Prof. Störmer's aurora-borealis expedition of 1913. The account is based on Prof. Störmer's own papers in *Terrestrial Magnetism* and his address to the Scandinavian Scientific Association, Christiania, in 1916. The observations of the auroræ were taken photographically from Bossekop and Store Korsnes, two stations in the North of Norway 27·5 kilometres apart; and they provide more than 2500 determinations of height which, in general, lie between 86 and 226 kilometres with a maximum number about 105 kilometres. The angular distances of the auroræ from the north magnetic pole of the earth lie between 20° and 25°, with a maximum frequency at about 23°. The following types of display are distinguished:—(*a*) Intense curtains, red below, greenish-yellow above; (*b*) faint curtains, green to greenish-grey; (*c*) arches; (*d*) faint zones; (*e*) isolated rays; (*f*) luminous areas; (*g*) coruscating bands; (*h*) coruscating areas. Although the theoretical examination of these observations is not yet complete, it seems likely that the corpuscular theory, according to which auroræ are due to electrically charged particles entering the earth's atmosphere and describing paths determined by the earth's magnetic field, will explain most of the known facts.

The U.S. Bureau of Standards has issued a new edition of its publication on polarimetry, with special reference to its technical applications, more especially to saccharimetry and the refractometric examination of solids and liquids. The bulletin deals with the various polarising systems in use, and contains a description of the different polarisers and polariscopes which have been found to be generally applicable to practical requirements, and explains the best methods of their employment so as to secure uniformity and accuracy of results. It treats of the various sources of light to be used in connection with polarimetric work and the several pieces of subsidiary apparatus required, the control and regulation of temperature, the employment of thermostats, temperature correction, etc.—in fact, all the details to be followed in accurate testing work of the kind. It has been put together to serve the needs of the practical man; it is simply and concisely written, and its account of the fundamental principles upon which modern polarimetry is based, whilst sound and accurate, may be readily followed by any ordinarily intelligent reader. The present edition (the second) has been carefully revised, and a considerable amount of additional matter has been included in the appendix. The new material comprises ten tables, new Bureau of Standards Baumé scale for liquids heavier than water, a *résumé* of the work of the International Commission for uniform methods of sugar analysis, a special section on the polarisation of low-grade products, together with a statement of the amendments of the United States Treasury Department sugar regulations. The work is admirably printed and illustrated, and highly creditable to the Washington Government Printing Office. It is now ready for distribution at a price of 25 cents, and those interested may obtain a copy by addressing a request to the Bureau of Standards, Washington, D.C., U.S.A.

Discussing the question of the organisation of chemical research in India, Sir Thomas Holland, president of the Indian Munitions Board, urges in an address given at Lahore that India must be independent not only industrially, but also to a large extent in regard to scientific research. India should have its own research workers carrying out investigations on the spot. The task of training the educated young men of India to qualify for research and technical work should be an essential part of the organisation of every scientific and technical department in that country. Because European beet-sugar has been able to compete successfully with Indian cane-sugar, and synthetic indigo has practically destroyed the Indian indigo industry, it has been generally assumed that tropical countries will not be able to hold their own against European and American competition; but what can be done in Europe under the (relative) disadvantages of a temperate climate could, the speaker argued, be done still more abundantly and successfully in India. It will, however, be necessary to bring the isolated chemists of India into one organisation, and an official scheme to this end had been mooted. At present only the fringe of the various great chemical problems in India has been touched. These include questions relating to agriculture, forest products, drugs, perfumes, dyes, and tanning; the manufacture of salt, sugar, alcohol, and explosives; saltpetre refining, mineralogy, and metallurgy. It is suggested that for administrative purposes researches on these matters might be centred in three groups: (*a*) Agricultural chemistry, with the chief laboratory at Pusa; (*b*) organic chemistry, with two principal laboratories at Dehra Dun and Bangalore; and (*c*) mineral chemistry, with the chief laboratory at Kalimati or Calcutta. The address is reported fully in the *Pioneer Mail* for January 18, and a detailed abstract appears in the Journal of the Society of Chemical Industry for April 15.

OUR ASTRONOMICAL COLUMN.

NEBULOSITY IN STAR CLUSTERS.—In a letter to the *Observatory* for June Dr. Harlow Shapley states that the appearance of nebulosity which has sometimes been noted in visual observations of star clusters has not been confirmed by the Mount Wilson photographs. In the case of the cluster No. 361 of Dreyer's Index Catalogue, the photographs show stars fainter than 18th magnitude, but there is no trace of nebulous matter. The cluster N.G.C. 6760, which has also often been observed visually as nebulous, appears purely stellar on the photographs. The actual connection between luminous nebulosity and star clusters seems to be limited to stellar groups of little condensation and richness, where the brighter stars are mainly of type A or B. In these cases the nebulosity becomes visible because of direct reflection of the light of the surrounding stars, and partly on account of selective secondary radiation. Thus the frequent association of diffuse nebulosity with blue stars of high temperature does not necessarily indicate immediate evolutionary relationship. There is at present no certain evidence of luminous nebulosity in globular clusters.

INTERPRETATION OF STELLAR TYPES.—In a communication to the National Academy of Sciences, Washington, March, 1918, Prof. C. D. Perrine makes the interesting suggestion that the spectral class of a star is in part dependent upon the amount of cosmical matter in its neighbourhood and the relative velocity of the star and matter. Many of the A, B, and O stars, the gaseous nebulæ, the novæ, and possibly the Cepheid variables, on this hypothesis, are confined to the galaxy because there the energy derived from the matter swept up is in excess of that lost by radiation. The direction of spectral change under such conditions will be towards the nebulæ. In regions where there is little or no cosmical matter the energy gained from external sources is not sufficient to compensate for the loss of radiation, and the direction of change will be towards the later types. Upon this hypothesis the stars are probably all pursuing one definite course of very slow change towards extinction, but each individual star will be pursuing a course which may have many whole or partial cycles due to varying external causes.

THE STRATHMORE METEORITE.—This remarkable meteorite fell on December 3, 1917, at 1.18 p.m. Though in full sunshine, its brilliance was compared with the limelight, and it left a trail. It was seen so far away as Hexham, 120 miles from the earth-point. Prof. R. A. Sampson gives an interesting account of it in the Proceedings of the Royal Society of Edinburgh (vol. xxxviii., part i., No. 10). He fixes the explosion point as twenty miles above Collessie, Fife. Four fragments have been found, one penetrating a roof near Coupar Angus; the largest, weighing 22½ lb., fell at Easter Essendy Farm, near Loch Marlee; it made a hole 20 in. deep, the rubbish being piled to the north-west, showing the direction of motion, which agrees with other indications. The fragments did not fall until some minutes after the sounds of explosion were heard, showing how much the speed (which must initially have been some miles per second, to account for the brilliancy) had been reduced by atmospheric resistance. Prof. Sampson explains the heating of meteors by supposing that the air in front of them has not time to escape, so is rapidly compressed. Assuming probable figures for mass and velocity, he shows that a temperature of 2000° might be produced. The meteor is of the stony class, to which many people assign a volcanic origin. In view of the difficulty of understanding how it could have escaped from our atmosphere without rupture, if expelled from a terrestrial volcano, Prof. Sampson suggests a lunar origin. In this case it might either describe an orbit within the earth-moon system, or, with a higher speed, a planetary orbit about the sun. The latter would seem the more likely, Mr. Denning having shown that it probably came from a known radiant in Sagitta, which is active early in December. The lunar origin would then imply that a large shower of fragments was expelled from the moon during a single eruption.

THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES.

THE twenty-third annual congress of the South-Eastern Union of Scientific Societies was held at Burlington House, in the Linnean Society's rooms, on May 29 and three following days, under the presidency of Sir Daniel Morris. The presidential address was entitled "The Geographical Distribution of Plants," and was, to some extent, concerned with the various means of dispersal of seeds and the manner in which geographical distribution was effected. The destruction of the flora of the Island of Krakatoa by volcanic eruption and the comparatively rapid growth of a new flora gave valuable evidence as to the manner and time required for replacing a destroyed flora. Transport by water-currents, through a powerful agent, would be assisted by the agency of birds, and meteorological agencies must not be wholly left out of the reckoning. Many seeds reach our own shores from tropical America by the agency of the Gulf Stream, but these have not been known to germinate in a natural state after transportation.

Mr. Percy Webb's paper on "Romano-British Mints" was an excellent summary of the subject. Mr. Webb pointed out that it was probable that the province of Britain, accustomed to use and strike coins for nearly two hundred years before the Roman invasion, kept its mints in some operation even under Roman rule. There is no clear identification of mints owing to the system of mint-marking not commencing until a late period. Claudius struck types of coins relating to Britain, but they were no doubt issued and used in Rome. Hadrian issued bronze pieces on which appears the seated figure of Britannia, her first appearance in history. These coins, and others of the same type issued by Antoninus Pius, suggest in their less accurate mintage, and from the fact that they have come to light in numbers in British finds, that they are of colonial origin. From Carausius and Allectus we have indisputable British issues, the former the founder of the short-lived first British Empire, the latter defeated and slain by the Romans on Wolmer Common, near Liss, where his military chest was exhumed in 1873, having been buried before battle with its contents of nearly 30,000 coins.

The subject of "Mosquitoes in England" was introduced for discussion by Sir Ronald Ross, and amongst those who took part in the discussion were Col. Buchanan, of the Local Government Board; Capt. MacDonald, and Mr. A. J. Grove. Sir Ronald Ross pointed out that malaria had formerly been prevalent in Britain, but had afterwards died out. Anophelines, however, continued to exist in certain low-lying parts, and recently evidence has been found to suggest that malaria has really continued all the time to be endemic to a very small degree in parts of Kent. Last year some cases undoubtedly occurred in this country. Certain alarmists are seriously perturbed by the possibilities of its greater prevalence. Sir Ronald came to the conclusion that the spread of malaria in a community must depend upon about fifteen different factors. "Of all the millions bred in a locality, possibly only a few can ever succeed in biting a human being at all. Then only a proportion of these will generally have bitten an infected human being; and, again, only a smaller proportion will have bitten an infected person whose blood contains sexual parasites suitable for transmission into a mosquito. Hence the chances usually are that only a very small proportion of all the Anophelines in a place will ever become infected at all. But how many of these will infect healthy persons? A mosquito must live for about ten days at least before the parasites can mature in her body and enter her salivary glands, and of the small proportion of mosquitoes which may live long enough for this a still smaller proportion are likely to succeed in biting and infecting healthy persons afterwards. Men and mosquitoes may vary in individual resistance to parasites. Both will be infective to each other only at certain times. The general equations for diseases common to two species of hosts contain fifteen independent constants, or, rather, parameters—namely, the birth-rate, death-rate, immigration, emigration, immunity, infectivity, and recovery ratios for each species of host, and the contact ratio common to both; and the total proportion of infected individuals of either species must depend on all of these combined in certain mathematical functions." A special appeal was made to the members of local societies to make a study of the bionomics and distribution of mosquitoes in Britain.

A lecture was given by Mr. Reginald Smith, of the British Museum, on the "Geology of Flint Implements." In the course of many interesting remarks, the Mousterian cave-finds from St. Brelade, Jersey, were illustrated, and compared with certain surface-finds in England. The hope was expressed that further research in England, which had the advantage of the boulder-clay, might decide man's relation to the glacial period by associating definite types of flint-working with deposits both before and after the most intense glaciation of the country. Much information had been lost to science by inattention to the labelling of specimens as to their place of origin and the position in which found.

Other papers were: "Meteorological Instruments and How to Read Them," by Mr. R. Corless, of the Meteorological Office, and by Lieut. R. W. Ascroft, of the Food Production Department, on "Allotment Pests." Among the afternoon excursions may be mentioned visits to the New Transport Co.'s works at Battersea, where heavy goods are sorted by machinery, on the principle of a central goods clearing-house; to the church of St. Bartholomew the Great; to the classic Charlton Pits, under the guidance of the veteran geologist, Mr. W. Whitaker; to Kew, under that of Lieut.-Col. Sir David Prain and Prof. G. S. Boulger; and to the diving and mine-rescue apparatus works of Siebe, Gorman and Co., under the direction of Dr. J. S. Haldane. The congress was well attended, and apparently justified the council in deciding to hold it this year as usual.

THE TREATMENT OF MALARIA.[1]

THE treatment of malaria has engaged the attention of the medical department of the War Office since the outbreak of the war. So soon as cases of this disease began to return to England malaria hospitals were opened, and in certain large hospitals special wards were set apart so that all patients could be concentrated and treated by physicians with special knowledge of malaria. This branch of the medical work was placed under the supervision of Col. Sir Ronald Ross, K.C.B., F.R.S., consultant in malaria, War Office, and an interim report now published by this officer gives the results of treatment of a number of cases in four of the hospitals under his control up to the date of publication.

Before commencing treatments, 193 patients who had previously taken quinine, but who had recently discontinued the drug, were observed without further medication with the view of determining approximately the liability to relapse without further treatment. Of these 193 patients, 88 had relapses within twenty-seven days. Owing to illness (unfortunately not specified), 76 had to be given quinine without continuing the control. After a month, only 15 per cent. were free from relapse, and were considered well enough to be discharged; 85 per cent. were still showing symptoms of the disease.

Two thousand four hundred and sixty cases of malaria were treated under one or other of the following methods:—

(*a*) *Anti-relapse Quinine Prophylaxis*.—Quinine sulphate in small doses by different methods up to 60 grains weekly was given to 1040 cases. A dose of 10 grains daily was found to be more effective than one of 5 grains, and was more suitable than one of 15 grains, because, as well as being equally effective, it was better tolerated. Under these treatments relapses were reduced to 10 per cent., and even in relapses not so reduced the severity of the paroxysms was diminished.

(*b*) *Short Sterilising Treatments*.—Large doses of quinine sulphate, hydrochloride, or bi-hydrochloride were given daily for seven days, or on consecutive days up to ten days, to 334 cases. A high percentage of these cases relapsed.

(*c*) *Long Sterilising Treatments*.—Large doses of the same salts of quinine as in treatments (*b*) were given daily over long periods, continually, or on consecutive days, or at intervals of several days. Some of these treatments appear to have given the best results, especially the three treatments (*c*) 15, 16, and 17. Two of these were combined in the later stages with iron and arsenic. It may be noted that, in the experience of some observers, much intolerance is shown during the large dosage as here used, without more appreciable diminution of the number of relapses than results from less heroic lines of treatment.

(*d*) *Mixed Treatments*, including the administration of drugs other than quinine in the combinations generally used, were given in different doses for varying periods. The drugs used were tartar emetic, acid arsenoids, sodium quinine sulphonate, ethyl quitenine hydrochloride, and collosol quinine. Only a few cases were treated with each drug, as nearly all these relapsed.

Sir Ronald Ross points out that he has not noticed any marked superiority in the oral, intramuscular, or intravenous methods of administering quinine. He advises that a much larger number of cases should be controlled before the efficacy of any particular drug over others can be determined. Obviously it is necessary to observe cases carefully for a much longer period than twenty-seven days after they leave hospital before it is possible to decide what is the actual liability to relapse.

A generous diet is recommended during treatment, with a little stimulant in the form of beer or wine. Opinion seems divided as to whether patients should be kept in bed or not during treatment.

A second paper expressing the opinions of medical officers in the Salonika area as to the value of prophylactic quinine and on the treatment of malaria under different conditions of service was afterwards read by Sir Ronald Ross before the Society of Tropical

[1] Society of Tropical Medicine. (1) An Interim Report on the Treatment of Malaria. (2) Report on a "Discussion on the Treatment of Malaria." Both by Sir Ronald Ross.

Medicine. Of 111 officers interrogated on the prophylactic value of quinine in 10-grain doses twice weekly, their opinions were divided, the majority holding that it was of little or no value, and some even saying that it was detrimental. For treatment in an advanced dressing station for three days, one officer considered that quinine should be given in 80-grain doses daily. The majority (about 63 per cent.) were in favour of 30 grains daily.

For treatment after return to duty subsequent to the above, nine officers advised stoppage of all quinine; seventy-three considered that the drug should be continued for from one to three and a half months in daily doses, according to different opinions, of 10, 20, or 30 grains. Some recommended gradual reduction of the amount of daily quinine during the same period.

In treating cases following discharge from hospital the treatment advised was much the same, the medical officers expressing the same opinions practically as for cases leaving dressing stations. Subsidiary treatment was recommended by some. Continuance of quinine until the end of the malarial season had also some supporters.

Both these papers include an account of a large amount of work done by many skilled officers, and should serve as a valuable guide to officers and medical men who have charge of malarial cases or intend carrying out further investigation work on this very important subject. It is desirable that an effort be made to ascertain definitely why quinine, so successful in the majority of cases, should fail in others.

An interesting addendum to the first report deals with the excretion of quinine in the urine. It seems that there is a tendency for the excretion of quinine to reach a concentration of 7–11 grains per litre of urine. These results obtained no matter what salt was given or how administered, except, perhaps, in the case of the lactate. F. W. O'CONNOR.

SCIENTIFIC PROBLEMS OF DISABLED SOLDIERS.

WE commend to the attention of our readers the April issue of *Recalled to Life,* a journal edited by Lord Charnwood, and devoted to "the care, re-education, and return to civil life of disabled sailors and soldiers." Its articles are written by men who are seeking for practical solutions of the problems presented by disabled soldiers—problems which are both medical and sociological. Half of the men who are wounded require special treatment for the restoration of movement to damaged limbs. Great military hospitals have been, and are being, established in various centres throughout the country for the treatment of these orthopædic cases. The establishment of these great "orthopædic" centres has been accompanied by a real educative movement, in which surgeon and soldier have been equally involved. It is true that no new principle of treatment has been introduced; the old methods have been adapted to new conditions and applied on a scale which no one had ever anticipated.

Sir Robert Jones, who contributes an article on "The Problem of the Disabled," was the first to realise that success in the treatment of orthopædic cases was largely a problem of education—to teach soldiers how to bring back lost movements to damaged joints by voluntary and natural movements of the limbs. The introduction of "curative workshops" to military hospitals is one of the most profitable innovations of the war. Of the men treated in orthopædic hospitals about three-fourths return again to military service; the remaining fourth is discharged as unfit for further service. It is now the business of the Ministry of Pensions to look after the welfare of that discharged fourth.

Various writers describe the organisations which are being brought into existence to meet the needs, not only of the men discharged from orthopædic hospitals, but also of the large numbers rejected by the Army on account of a permanent breakdown in health due to exposure in the field, resulting in rheumatism, tuberculosis, disordered action of the heart or of the brain. To meet the needs of the discharged unfit the Ministry of Pensions is establishing throughout the country centres of treatment and superintendence. An ideal form of "village centre" for the cure and training of discharged men is described by Mr. Warwick Draper. Major Dundas Grant contributes an article on the training of the deaf soldier. Everywhere the importance of "self-help" is emphasised. Capt. Wilbur C. Lowry, of the Canadian Army Medical Service, while giving an account of the "remedial exercises" practised in the orthopædic gymnasium Granville Canadian Special Hospital, Buxton, mentions the fact that the best teachers are to be found amongst the men who themselves have undergone gymnastic treatment.

CLIMATOLOGY OF PARIS.[1]

M. FLAMMARION, in the comprehensive report referred to below, not only gives a summary of the meteorological conditions in Paris during the years 1915 and 1916, but also carries the comparison of the seasonal variations of the principal climatic elements back to 1886. The year 1915 had a mean temperature equal to 10·4° C., or 0·2° above the normal, while 1916 was in even closer accordance with the average. The rainfall of 1915 was 574 mm., and of 1916 698 mm., or respectively 3 per cent. and 22 per cent. above the average. The author concludes that "in spite of the frightful intensity of the cannonades; they have exerted no influence on the rainfall in the region of Paris." In 1915 less than half the average fell in the months of March, May, and October, the only month showing an excess being December, when, however, the rainfall was more than double the average. This was followed by a very dry January (1916), with less than a quarter of the average. Although somewhat wetter than 1915, no month in 1916 had an excess of rain greater than one-third of the average.

Some remarkably low barometric pressures are referred to, the most notable being those of November 12–13, 1915, and November 18, 1916. On the former occasion pressure fell to 723 mm. (28·46 in.), the rise after the minimum being extremely rapid, amounting to 25 mm. (0·99 in.) in fifteen hours. On the latter date pressure descended to 713 mm. (28·07 in.), this being the lowest reading in the vicinity of Paris since December 24, 1821. In 1915 temperature was somewhat abnormal, the coldest month, November, having a mean temperature 4° C. lower than that of December. In 1916 the lowest temperature occurred as late as March 8, while the month of June was colder than May. An interesting diagram is given for each year of the daily variations of the various elements of climate, the phases of the moon being also shown, as the author remarks that "the ignorant" still continue to associate weather phenomena with the lunar period.

[1] "Rapports sur les Travaux de la Station de Climatologie agricole de Iuvisy pendant les Années 1915 et 1916." Par M. Camille Flammarion Directeur de la Station. Pp. 41.

THE STORY OF A GRASS.[1]

GRASSES form one of the largest and most widespread families, adapted to very different conditions of soil and climate, but with a remarkably uniform plan of structure. Wherever conditions allow of plant-life on land, there, almost without exception, the family is represented. In number of species the grass family falls short of other great families of flowering plants, Compositæ, Leguminosæ, or Orchids, but in the aggregation of many individuals of one and the same or a few species, either growing alone or densely scattered through a mixed herbage covering large areas, it forms a pre-eminent type of the earth's vegetation—as, for instance, in the grass-carpets forming the meadows or pastures of temperate or cold climates, or the coarser growth prevalent over vast areas, as in steppe or prairie vegetation.

These sociable grasses play an important part in the general scheme of plant-life; they protect the soil from too great evaporation of water, and cover up other plants in the resting stage, such as bulbs, tubers, etc., during the cold or dry season. The penetrating effect of the roots and underground stems helps to break up a stiff soil and fit it for other plants. Examples of the great variety of habitat in which grasses thrive are seen in the short turf which covers limestone areas, where the soil is too dry and thin to support trees or shrubs; in the luxuriant growth of meadow-land where it thrives together with a variety of other herbs; in the reed-grasses which are associated with water; in the coastal mud-flats in Hampshire and Sussex, which are being rapidly reclaimed by the growth of *Spartina Townsendi*, a vigorous-growing hybrid which has spread over large areas during recent years; or the sand-dune grasses, which bind and fix the sand dunes and prepare the way for a more varied and permanent type of vegetation.

The adaptation necessary to accommodate the plant to widely differing conditions of life does not involve changes in general plan of structure; for instance, in hot, dry, or exposed areas, where excessive loss of water by the plant must be avoided, this is effected by narrowing the leaf-surface, or rolling it over from margin to margin to protect the upper face on which are the water-transpiring stomata. The structure of the stem, a slender, hollow cylinder, strengthened by a band of supporting fibres beneath the outer layer, or strips accompanying the water-conducting tissue, gives sufficient strength, with the greatest economy of material, for the purpose required, namely, to carry up into the light and air the leaves, flowers, and fruits for the short period of active life, and to allow of the swaying motion which favours the processes of nutrition, of transfer of pollen, and of distribution of the mature fruits.

The mode of development of the branches at the base of the stem determines the habit; a tufted growth results from the upward growth of the buds in the interior of the leaf-sheath, as seen, for instance, in the "tillering" of cereals; while the turf- or sod-formation is due to the penetration of the sheath-base by the young shoot and its lateral development in the soil. Branching from the upper part of the stem is rare in grasses of the temperate zone, but occurs in tropical genera, and is characteristic of the bamboos, in which the woody stem often attains tree-like proportions.

Points of interest in the structure of the grasses are the mode of growth in length of the stem by a zone of growth above the place of insertion of each leaf, the rigidity of the stem at this tender-growing zone being maintained by the stiff, encircling leaf-sheath; the swollen "node" round the base of each leaf-sheath, which is able by a geotropic growth response to an alteration in its position to raise again to a vertical position a stem which has been laid; and the short prolongation of the leaf-sheath above the line of its union with the leaf-blade to form the membranous "ligule" which protects the entrance to the tube formed by the sheath.

The grass-flower and the association of flowers to form the inflorescence are very characteristic. The unit is the spikelet which contains one to several, sometimes many, flowers. The character of the spikelet is determined by the bracts or glumes, the green membranous or papery scale-leaves which enclose the single flower and overlap each other in a double row when several flowers are present in a spikelet. The bract-leaf is a general method of protecting the flower-bud; in the iris, for example, each flower-bud is enveloped by a pair of bracts—the outer, farther from the main stalk, green and leaf-like, the inner, between the bud and the main stalk, thin and hyaline with a double keel on the back. In the iris the bracts wither as the flower opens, in the grass the bracts remain as the character-giving feature during flowering and fruiting, the flower itself being reduced to those organs which are directly concerned in the setting of the fruit. The pollen is distributed by means of air-currents, and the petals are represented merely by a pair of minute fleshy scales (lodicules) at the base of the flower, which, by absorbing water, swell and cause the bracts to separate, and thus allow the thread-like stamens to grow out and expose the delicately hung anthers, from which the light dusty pollen is scattered by the wind; the feathery stigmas protrude later to catch the pollen-grains. In the great majority of grasses there are three stamens, as in the Iris family, and a single ovary bearing a pair of long, feathery stigmas and containing a single egg. The remarkable variety in the form of the spikelet and the inflorescence is achieved by variety in the form, size, and number of the glumes which constitute the spikelet and the degree of branching of the inflorescence. The colour of the inflorescence is due to the colour of the pendulous anthers, and disappears when these drop after shedding the pollen. Fertilisation of the ovule succeeds pollination of the stigma, and the ovule becomes the seed, which, except in a few genera, is permanently enclosed in and inseparable from the fruit. The fruit also generally remains enclosed in one or more of the glumes, which fall with it and by their light, papery consistency help in its distribution by wind. Frequently the outer glume bears a stiff awn on the back or tip, which is an effective aid to distribution, as it will cling to the coat or plumage of an animal or bird. In the steppe grasses of the genus Stipa the awn is sometimes very long and feathered, forming an admirable device for distribution by wind. The stiff awn is frequently spirally coiled in its lower portion and hygroscopic, and its coiling or uncoiling with the varying degree of moisture in the atmosphere is arranged so as to drive the pointed end of the glume, in which the fruit is enclosed, into the ground.

The seed contains the embryo at the lower part of one side; the rest consists of a food store of starch and gluten to nourish the embryo on germination. The embryo has a well-developed stem-bud or plumule and root; the plumule is enveloped by a sheath (coleoptile), which appears above ground in germination as the slender pointed green seed-leaf from which the true leaves successively break. The food store in

[1] Abstract of a discourse delivered at the Royal Institution on May 17 by Dr. A. B. Rendle, F.R.S.

the seed is rendered soluble and absorbed by a flat sucker (scutellum), which is attached to the base of the coleoptile, and together with it represents the single cotyledon characteristic of the division of flowering plants, Monocotyledons, to which the grass family belongs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Sir William Ashley, Dean of the faculty of commerce, has been invited to become Vice-Principal in succession to Dr. R. S. Heath, whose resignation takes effect at the end of the current session. The post of registrar, hitherto occupied by Dr. Heath, is to be filled by Prof. Alfred Hughes, Dean of the faculty of arts.

CAMBRIDGE.—The governing body of Emmanuel College offers two exhibitions, each of the value of 50*l.* and tenable for two years, to research students commencing residence at the college in October, 1918. The governing body may also make additional grants to students whose means are insufficient to cover the expense of residence at Cambridge or whose course of research may entail any considerable outlay in the provision of apparatus or materials.

OXFORD.—Prof. Horace Lamb, professor of mathematics in the University of Manchester, has been appointed Halley lecturer for next year.

THE *Times* correspondent at Toronto states that a prominent citizen, whose name is not yet disclosed, will give from 100,000*l.* to 600,000*l.* to endow chairs in the faculty of medicine at the University of Toronto.

BY the will of Sir G. H. Philipson, the sum of 2000*l.* has been left to the University of Durham College of Medicine, Newcastle-upon-Tyne, for the foundation of two Philipson scholarships to be awarded to the undergraduate of the college obtaining the highest marks at the M.B. final examination.

THE sum of 2500*l.* has been given to the Armstrong College, Newcastle-upon-Tyne, by Miss Stephenson, for the endowment of a studentship in the faculty of arts, in memory of her late father, Sir W. H. Stephenson; and Messrs. Cochrane, Ltd., of Middlesbrough, have given 3000*l.* to the same institution for the foundation of scholarships, primarily for residents of Middlesbrough and New Brancepeth.

THE Regulations for Secondary Schools for 1918–19 (Cd. 9076, price 2*d.*), now published by the Board of Education, are in substance the same as those for the present year. The definition of advanced courses for pupils remaining in secondary schools until eighteen years of age has been revised and modified. It will be remembered that the Board's circular of 1913 on the curricula of secondary schools pointed out that the legitimate requirements of the great majority of pupils would be met by the provision of three different types of advanced course, viz. (*a*) science and mathematics, (*b*) classics, and (*c*) modern humanistic studies. The requirement that the work of an advanced course in group (*a*) must include both science and mathematics has now been relaxed. In schools, especially girls' schools, where biology occupies a prominent place in the curriculum, it is not always possible without risk of serious overstrain to require the inclusion both of mathematics and of the auxiliary sciences of chemistry and physics. The Board has therefore reserved discretionary power to dispense with the requirement of mathematics in such cases. It is expected that chemistry will always be continued in the advanced course in connection with biology, and that physics will also be continued unless it has previously been carried to an adequate standard. The claims of geography for recognition as an advanced course are discussed in an explanatory note to the regulations, and it is stated that the Board is prepared to give sympathetic consideration to any practicable proposals made by suitable schools for advanced courses in which geography is made a predominant subject.

ONE chapter of the recently published report of the Board of Education for the year 1916–17 (Cd. 9045) is concerned with the work of universities and university colleges. It includes a section dealing with the gifts and bequests received during the year under review by the university institutions which come within the scope of the report. The majority of the foundations were directed to promoting the study of subjects the importance of which has been emphasised by the war. Among the gifts recorded the following may be mentioned:—A legacy to the University of Birmingham of 5000*l.* from the late Sir Charles Holcroft, the income of which is to be devoted to research work in science and engineering; a bequest of 10,000*l.* from the estate of Miss Craddock for the purpose of founding a chair of commerce at the University of Liverpool; 25,000*l.* under the will of Sir George Franklin for the foundation of chairs at the University of Sheffield; 30,000*l.* contributed to the Ramsay Memorial Fund; some 30,000*l.* given towards the erection of new science buildings at Bangor University College; 20,000*l.* promised by anonymous donors to Aberystwyth College for buildings required by the Agricultural Department; and at Cardiff 25,000*l.* received from Sir W. J. Tatem towards the provision of new chemical laboratories, a bequest of 20,000*l.* to the Medical Department, and a sum of 30,000*l.* from Miss Emily Talbot to endow a chair of preventive medicine. Altogether, well over 200,000*l.* was found by private donors for the improvement and development of higher education, in addition to the gifts of land, like the site of nine acres in the heart of Bristol given to the University there by Mr. Henry Wills, part of which is marked out for the erection of a department of physics. The benefactions to universities and colleges in the United States exceed 5,000,000*l.* annually, or twenty-five times more than the gifts to similar institutions in Great Britain.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 6.—Sir J. J. Thomson, president, in the chair.—N. B. **Dreyer** and Prof. C. S. **Sherrington**: Brevity, frequence of rhythm, and amount of reflex nervous discharge as indicated by reflex contraction. A single momentary stimulus of moderate intensity, *e.g.* a break-shock, even though not far above threshold value of stimulation, applied to the afferent nerve of a spinal reflex-centre, evokes from that centre not uncommonly a repetitive series of volleys of motor impulses. It tends to do so more as the stimulus, within limits, is increased in intensity, but the state of the reflex-centre at the time is also a decisive factor. The rhythm of repetition of volley-discharges from the spinal reflex-centre was traced, by the ordinary mechanical method, to be of synchronous rate with that of stimulation of the afferent nerve up to a frequence of 55 per sec., and by a mechanical resonance method up to a frequence of 65 per sec. By a "doubling frequency" method it was shown further that the frequence-rate of the reflex discharge has not reached its limit under a stimulation of 75 per sec., but surpasses that degree, though by what amount the method cannot say. The maximal mechanical power of a muscle contracting under spinal reflex action is frequently as great as the maximal which can be evoked from it by direct faradisation of the motor nerve itself.

Geological Society, June 5.—Mr. G. W. Lamplugh, president, in the chair.—W. D. **Lang**: The Kelestominæ, a sub-family of Cretaceous cribrimorph Polyzoa. The Kelestominæ are a sub-family of Pelmatoporidæ. The latter are a family of Cretaceous cribrimorph Polyzoa, the costæ of which are prolonged upwards as hollow spines from the median area of fusion of the intraterminal front wall. The broken ends of these spines form a row of pelmata (or, if small, pelmatidia) on the intraterminal front wall. The Kelestominæ are Pelmatoporidæ with an apertural bar, each half of which is bifid; and the proximal and distal forks of each half are fused with the corresponding forks of the other half. The fused distal forks are also fused with the proximal pair of apertural spines, which are greatly enlarged. The simplest known form of this arrangement is seen in the genus Kelestoma, Marsson. Morphasmopora, unlike Kelestoma, retains a small number of costæ and a short œcium; but the thickness of the proximal apertural spines, which are scarcely recognisable as such, is enormously increased; the thickness of the bifid apertural bar is also increased.—Dr. R. L. **Sherlock**: The geology and genesis of the Trefriw pyrites deposit. This pyrites deposit is worked at Cae Coch Mine, on the western side of the Conway Valley (North Wales), about one mile north of Trefriw. A band of pyrites, about 6 ft. thick, and of considerable purity, rests on the inclined top of a thick mass of diabase, which is shown to be intruded into the Bala shales that cover the ore-body. Pyrites deposits are classified by Beyschlag, Vogt, and Krusch into four groups:—(1) Magmatic segregations; (2) formed by contact-metamorphism; (3) lodes; (4) of sedimentary origin. None of these modes of origin, however, will account for the Trefriw pyrites. The conclusion arrived at is that the diabase was intruded below a bed of pisolitic iron-ore. Hot water containing sulphuretted hydrogen given off from the intrusion combined readily with the pisolites, which were in the form either of oxide or of silicate of iron, and formed pyrites. The graptolitic horizon at which the pisolitic ore occurs usually contains some pyrites, and this would be added to that derived from the above reaction.

Linnean Society, June 6.—Sir David Prain, president, in the chair.—C. C. **Lacaita**: A revision of some critical species of Echium as exemplified in the Linnean and other herbaria, with a description of *Echium judaeum*, a new species from Palestine.—Capt. A. W. **Hill**: A series of seedlings of Cyclamen. Normally only one cotyledon develops, the other remaining as a rudiment at the apex of the hypocotyl or tuber. If the lamina of the cotyledon be removed, new laminæ arise as outgrowths from the petiole just below the cut surface; but if the cotyledon with its petiole be removed, the rudiment of the second cotyledon is stimulated to develop into an assimilating organ. On removal of the lamina of this second cotyledon new laminæ will be formed from the inner edges of its petiole close to the apex, exactly as is the case with the cotyledon proper. When plumular leaves are so treated no new laminæ are regenerated. Further cotyledon leaf-cuttings will produce roots from the base of the petiole, while plumular leaf-cuttings remain rootless.—R. **Paulson** and S. **Hastings**: The relationship between the symbionts in a lichen. *Cladonia digitata*, Hoffm., is the lichen used as material for many of the authors' preparations. This plant grows at the base of trees in shady woods in Hertfordshire and Essex, as well as in most northern localities. The gonidium is spherical, except when subject to pressure from other gonidia. The diameter of fully developed cells ranges from 8 to 15 μ; the chloroplast in the mature gonidium has an uneven surface; after fixing and staining, minute reticulation of the cytoplasm is evident; the so-called pyrenoid is large and central, and exhibits a distinct structure throughout the substance, its diameter is roughly one-third that of the chromatophore; a small lateral body stains darker than the pyrenoid, it is very conspicuous in many of the preparations surrounded by a very lightly stained area. Twin gonidia frequently occur; there is no vegetative cell-division of the gonidium; the increase in the number of gonidia results from the formation of autospores, reduced zoogonidia; there is no penetration of gonidia by hyphæ.

Mathematical Society, June 13.—Prof. E. W. Hobson, vice-president, in the chair.—Prof. M. J. M. **Hill**: An assumption in the theory of singular solutions of ordinary differential equations of the first order.—Col. A. J. **Cunningham** and Th. **Gosset**: Quartic and cubic residuacity tables.—Col. A. J. **Cunningham**: Lucas's process applied to composite Mersenne numbers.—Dr. A. E. **Western**: The Gaussian period numbers and the conditions that 2 should be a residue of a 16th or 32nd power.—T. W. **Chaundy**: The aberrations of a symmetrical optical system.—T. L. **Ince**: The rotation groups of the regular figures in four or more dimensions.—J. H. **Grace**: (1) An analogue in space of a case of Poncelet's porism. (2) Note on enumerative geometry.—E. K. **Wakeford**: Posthumous MS. discovered in his kit.

EDINBURGH.

Royal Society, June 8.—Dr. John Horne, president, in the chair.—Miss L. H. **Huie**: The formation of the germ-band in the egg of the holly tortrix moth (*Eudemis naevana*). The following main results were obtained. The egg laid in July and August is much flattened, having the form of an oval scale, the ventral surface of which adheres to the leaf. The shape of the egg and the transparency of the envelopes make this a convenient material for the study of the early development of a lepidopterous insect. An account was given of the stages leading to the formation of the blastoderm, the ventral plate, the amnion, the germ-band, and the "inner layer." This last becomes segmented almost at once, but the ectoderm remains unsegmented during the winter.—Prof. R. A. **Sampson**: Studies in clocks and timekeeping. No. 2.: The circular equation. The present communication is the second of a series of studies executed at the Royal Observatory upon precision clocks and timekeeping. The astronomical interest of these studies comes from their ultimate bearing on the rotation of the earth, which is our standard of timekeeping. Their plan is to accumulate with sufficient care and detail the necessary observations and discussions upon all points at present obscure or imperfectly treated which may affect the timekeeping of a clock. The present paper contains the calculation of the theoretical effect upon the clock's rate of any variation of arc of oscillation of the pendulum. The formulæ, which are known, are here reduced to tables for convenient reference. The comparison of these theoretical results with actual performance is reserved for future members of the series.—Dr. C. **Davison**: The sound-waves and other air-waves of the East London explosion of January 19, 1917. This is the complete report of the facts collected on the occasion of the East London explosion on January 19, 1917 (see NATURE, February 1, 1917, p. 438, and August 2, 1917, p. 450, in which the main conclusions were anticipated).—Sir Thos. **Muir**: The quadratic relations between the determinants of a 4-by-8 array. The main idea of the paper was to develop a convenient notation to facilitate the analytical use of these arrays.

CAPETOWN.

Royal Society of South Africa, April 17.—Dr. J. D. F. Gilchrist, president, in the chair.—Dr. J. D. F. **Gilchrist**: Luminosity in a South African earthworm and its origin. Luminous earthworms are found on the slopes of Table Mountain. The luminosity proceeds from a discharge from the mouth and anus, which consists of cells heavily laden with inclusions of different kinds. The smaller inclusions consist of a substance allied to fat, by the oxidation of which the light is produced. The cells arise from the body cavity, and are discharged into the anterior and posterior parts of the alimentary canal by definite communications between the cœlom and alimentary tract.—Sir Thomas **Muir**: Note on the adjugate of Bezout's eliminant of two binary quantics.—I. B. P. **Evans** and Averil M. **Bottomley**: The genera Diplocystis and Broomeia. Some specimens of Diplocystis have recently been obtained by the authors from Portuguese East Africa, and this is the first recorded occurrence of the interesting genus from Africa. The African material is not identical with that from Cuba, and the authors describe it as *Diplocystis Junodii*, nov. spec.—Ethel M. **Doidge**: South African Perisporiaceæ, ii. Revisional notes. This communication consists of a revision, due to work on a number of fresh collections of South African Perisporiaceæ, of a previous communication on the subject by the author.—F. G. **Cawston**: Fresh-water snails as a cause of parasitic diseases. The author describes a number of snails collected by him from various districts in South Africa, and found to be infested with the cercarial stages of the various trematode worms.—J. **Moir**: Colour and chemical constitution, part iv. The remaining phthaleins. The absorption spectra of complex phthaleins are described, these being partly duplex compounds of the phenol-anthrol type and partly of a new class (*e.g.* thymol-naphthol) derived from thymoylbenzoic acid. The additive nature of the effects of different substitutions is emphasised by means of a table giving the numerical value of the change of wave-length for different substituting groups.

BOOKS RECEIVED.

The Chemical Analysis of Iron. By A. A. Blair. 8th edition. Pp. 318. (Philadelphia and London: J. B. Lippincott Co.) 21*s.* net.

Fisheries of the North Sea. By N. Green. Pp. vii + 178. (London: Methuen and Co., Ltd.) 4*s.* 6*d.* net.

Map Work. By V. S. Bryant and T. H. Hughes. Pp. 174. (Oxford: Clarendon Press.) 5*s.* net.

Is Man the Product of Evolution? By S. J. Whitmee. Pp. 24. (London: Headley Bros, Ltd.) 6*d.* net.

Wayfarings: A Record of Adventure and Liberation in the Light of the Spirit. By W. J. Jupp. Pp. 234. (London: Headley Bros., Ltd.) 6*s.* net.

Methods of Measuring Temperature. By Dr. E. Griffiths. Pp. xi + 176. (London: C. Griffin and Co., Ltd.) 8*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 20.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Physiological Basis of Thirst: Major W. B. Cannon.

LINNEAN SOCIETY, at 5.—Les espèces d'Alpheidæ rapportées par M. J. Stanley Gardiner de l'Océan Indien: Prof. H. Coutière.—(1) A Selection of Ferdinand Bauer's Landscapes, *c.* 1784. (2) Ten British Plants: G. Claridge Druce.—Exhibition of Lantern-slides representing a Series of Intermediate Forms of the Diatom Genera Navicula and Cymbella: Sir Nicolas Yermoloff.—Sex-segregation in the Bryophyta: E. J. Collins.—Phenological Observations in an Elementary School: A. O. Walker.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Cotton and the Cotton-mill Industry: The Hon. Sir Dinshaw E. Wacha.

MONDAY, JUNE 24.

ARISTOTELIAN SOCIETY, at 8.—The Moral Argument for Theism: Rev. W. R. Matthews.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Address by the Hon. Arthur Meighen, Canadian Minister of the Interior, attending the Imperial Conference.

TUESDAY, JUNE 25.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Sociology of the East Coast People, Formosa: S. Ishii.

AERONAUTICAL SOCIETY (Central Hall, Westminster), at 8.—Wilbur Wright Memorial Lecture: Some Outstanding Problems in Aeronautics: Prof. W. F. Durand.

THURSDAY, JUNE 27.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Periodic Irrotational Waves of Finite Height: Prof. T. H. Havelock.—The Diffraction of Electric Waves by the Earth: Dr. G. N. Watson.—Concerning Emotive Phenomena. II.: Periodic Variations of Conductance of the Palm of the Human Hand: Dr. A. D. Waller.—The Mechanism and Control of Fibrillation in the Mammalian Heart: Prof. J. A. MacWilliam.—The Development of the Sea Anemones, *Actinoloba dianthus* and *Adamsia palliata*: Dr. J. F. Gemmill.—The Occurrence of Multinucleate Cells in Vegetative Tissues: R. Beer and Agnes Arber.—The Epithelial Sheath of Hertwig in the Teeth of Man, with Notes on the Follicle and Nasmyth's Membrane: Dr. J. H. Mummery.—*And other Papers.*

FRIDAY, JUNE 28.

PHYSICAL SOCIETY, at 5.—A New Method of Measuring Alternating Currents and Electric Oscillations: I. Williams.—Demonstration of Coupled Vibrations: Prof. E. H. Barton and Miss H. M. Browning.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, JUNE 27, 1918.

A COMPENDIUM OF PHARMACY.

The Practice of Pharmacy. By Dr. J. P. Remington, assisted by Dr. E. Fullerton Cook. Sixth edition. Pp. xxviii + 25 to 1987. (Philadelphia and London: J. B. Lippincott Co.) Price 35*s.* net.

OF all the American works on pharmacy none is so well known as Remington's. Since the publication of the first edition in 1885 its popularity has been maintained, and from a comparatively modest size it has grown to a stately volume of nearly 2000 pages. It must, however, be borne in mind that the author has put a very wide interpretation upon the term "pharmacy," and has not used it in the restricted sense in which it is commonly employed in this country. In "The Practice of Pharmacy" he has embodied to all intents and purposes the whole of the Pharmacopœia of the United States and also the National Formulary, appending notes to the monographs where necessary. He has dealt with crude vegetable drugs, unofficial as well as official, and with chemical drugs, both inorganic and organic, together with many of their derivatives and most of the newer synthetic remedies. Thus, for example, in the section on cellulose he treats of cotton, styptic cotton, pyroxylin, oxalic acid, acetic acid, acetone, tars, phenols, coal-tar and products obtained therefrom, thus covering an extremely wide range of subjects. Pharmaceutical testing, including biochemical assays, and reagents for the analysis of urine, for the examination of blood, and for bacteriology are also discussed.

"The Practice of Pharmacy" is, therefore, essentially a hand-book or compendium and a work of reference, rather than a text-book for students. For the former purpose it appears to be well suited, as there are but few subjects connected with pharmacy concerning which information is not to be found in it; whereas the ground covered and the arrangement of the subject-matter render it unsuitable for use by students as a text-book.

American pharmacists have for a number of years enjoyed the reputation of excelling in practical pharmacy, and the part of the volume dealing with this subject is well written and fairly complete, although it does not convey the impression that the American pharmacist is in this respect appreciably ahead of his British colleague. Among the pharmaceutical presses, for instance, the double-lever press, which is a powerful and handy press, and undoubtedly the best for use in the pharmaceutical laboratory, might well have been included. The section on ampoules, now so important a means of preserving and distributing sterile solutions for medicinal use, would be improved by a more detailed description of the methods at the disposal of the pharmacist for filling them.

The crude vegetable drugs have been classified according to the nature of their chief constituents, a classification that has recently been advocated by Prof. Tschirch, but is difficult to carry out as the constituents are in many cases insufficiently known. This section of the work, particularly as regards the constituents of the drugs, stands much in need of careful revision in the light of the many recent researches in this field. In some of the "liquors" also revision is necessary, as, for example, solution of arsenious and mercuric iodide, which is made by triturating arsenious iodide with mercuric iodide and water until solution is effected in which, the author says, "no chemical change occurs." That the finished solution is apt to darken in colour is well known, but the restoration to normal colour by shaking it with metallic mercury or arsenium is surely a questionable proceeding.

These minor defects, while not materially detracting from the utility of the book as a work of reference, indicate the desirability of securing for the next edition the collaboration of several experts to each of whom a section should be allotted for careful revision. The scope of the work is so extensive that it is only by such a combination of experts that a thoroughly satisfactory result can be attained. Nevertheless, Remington's "Practice of Pharmacy" will continue to be for British pharmacists a mine of information on American pharmacy.

RECENT CHEMICAL ANTISEPTICS.

A Handbook on Antiseptics. By Dr. H. D. Dakin and Dr. E. K. Dunham. Pp. ix+129. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 7*s.* net.

THE object of this little handbook, so the authors state, is to give a concise account of the chief chemical antiseptics which have been found useful for surgical purposes during the present war. It appears at a very opportune moment, for, in spite of the disapprobation with which these substances are viewed in certain quarters, there is no indication that, as accessories to surgical treatment, they are losing in favour—rather the contrary. The septic character of most of the wounds received in France emphasised, at an early period of the war, the importance of a searching and systematic study of antiseptics. The result has been an array of new active substances. And this fact furnishes an additional *raison d'être* for the volume under review. Dakin's hypochlorite solution, Lorraine Smith's eusol, the chloramine antiseptics of Dakin and his collaborators, Browning's flavine antiseptics, and Morison's so-called B.I.P. paste, which have supplanted to a great extent the older preparations, have all appeared during the last four years. In most of the larger military hospitals these substances are known and used, but there must be a number of surgeons who have not access to the information except through occasional detached articles in the medical Press.

But the book serves another purpose. The authors have sought to place the subject on something like a scientific basis. The importance of a standard method of testing is emphasised; the remarkable influence of media in this connection is referred to, and an attempt is made to explain (though at present little understood) the nature and mechanism of the action. The book is divided into chapters. The introductory chapter deals with various groups of antiseptics and their properties, the laws governing disinfection, the modes of application, and the influence of media. This is followed by chapters on particular groups, beginning with the chlorine group, in connection with which Dr. Dakin's name is so closely associated. The phenolic group, the group of heavy metals, the dyes, and miscellaneous antiseptics such as hydrogen peroxide, ozone, iodine, iodoform, boric acid, etc., are treated in successive chapters.

The final chapter is devoted to special applications of antiseptics, such as the disinfection of "carriers" and that of drinking water, and the production of electrolytic hypochlorite from sea-water for disinfecting ships.

Although the pursuit of this subject has been attended in recent years with remarkable success, it must be admitted that the methods have been mainly empirical and to some extent fortuitous. There is still a wide field for more systematic research and study, for there remains very much in the chemical action of antiseptics which is obscure. For a book of 129 pages, and of such small dimensions, the price of 7*s*. seems excessive.

J. B. C.

MILK HYGIENE.

Principles and Practice of Milk Hygiene. By Prof. L. A. Klein. Pp. x+329. (Philadelphia and London: J. B. Lippincott Co., 1917.) Price 12*s*. 6*d*. net.

THIS book, as its title implies, has been written particularly for the veterinary inspector, but, nevertheless, there is in it a great deal of information which will be of value to the analyst, the bacteriologist, the sanitary inspector, and the dairy student.

A clear account is given in the first chapter of the Zeitzschman theory of milk secretion, according to which two distinct phases are to be recognised in the process. The first is the slow secretion of milk during the intervals between milking, whilst the second phase begins at the bidding of the stimulus due to the act of milking.

The chemical and physical properties of milk are dealt with in the usual way, and there is also a good description of the biological properties. This is followed by an outline of the various groups of bacteria commonly found in milk, and the changes which they directly or indirectly bring about.

Defects of milk, whether due to bacteria or to some disease of the animal, are dealt with very fully, and there is a good account of the influence of disease upon milk. Naturally, a prominent place is given to tuberculosis, and the writer divides cows which are liable to cause infection into three classes: (*a*) those suffering from tuberculosis of the udder, (*b*) those having normal udders, but showing disease in other parts, (*c*) those which exhibit no clinical symptoms, but react to the tuberculin test.

As a result of much careful investigation it would appear that the most hopeful lines upon which to work in order to obtain a supply of milk free, or relatively free, from tubercle contamination is to apply the tuberculin test and examine the cows frequently. Full particulars as to methods of examination and the interpretation of symptoms are given later on in the book.

Stress is laid upon the necessity for careful inspection of the cowshed and premises and the maintenance of a high standard of cleanliness in milking, feeding, cleaning, water supply, etc. The use of a partly covered milk-pail is also recommended, and this practice has increased considerably of late years in the United States.

There is one sentence in the chapter upon farm inspection which cannot be too strongly impressed upon all those who are connected with the production of milk; it is this: "The hygienic qualities of milk depend very largely upon the conditions existing at the source of supply." Many enlightened public bodies in this country have acted for some time past upon this axiom with excellent results. The score system of dairy inspection is also explained.

One chapter deals fully with pasteurisation, whilst the rest of the book is devoted to details of the methods used in the examination of milk.

OUR BOOKSHELF.

The Problem of Man's Ancestry. By Prof. F. Wood-Jones. Pp. 48. (London: S.P.C.K., 1918.) Price 7*d*. net.

IN this booklet Prof. Wood-Jones has expanded the substance of a lecture which received considerable attention from the Press when delivered at King's College, Strand, during the past spring. A new hypothesis as to man's origin is put forward and a new place is given to man in the zoological scale—a place far apart from that occupied by the anthropoid apes, with which Prof. Wood-Jones considers man has only a most remote relationship. To explain the number of "primitive" anatomical characters which are to be found in the human body and the number of "human" features which are to be found in that aberrant and diminutive primate Tarsius, the author supposes that both man and Tarsius have sprung from a common stem—one the root of which is represented in the Lower Eocene strata by Anaptomorphus and Necrolemur. "If man is a more primitive mammal than are monkeys and apes, and if he undoubtedly belongs to their phylum, then it follows that, far from being a descendant of the apes, he may be looked on as their ancestor."

No one who has patiently analysed the structural characters of man and of anthropoid apes, and noted the points in which they resemble each other and those in which they differ, can find a perfectly satisfactory genealogical tree to account for the distribution of the points of resemblance and points of difference. That difficulty must remain so long as we are ignorant of the manner in which heredity works in moulding anatomical features. But to one who has tried to solve these difficulties, Prof. Wood-Jones's hypothesis, while clearing away minor difficulties, substitutes much greater ones. We cannot, on his hypothesis, explain the very remarkable and unquestionable structural community which binds man and anthropoid apes together, unless we fall back, as Prof. Wood-Jones has done and as the late Prof. Hermann Klaatsch did, on "convergence phenomena." There can be no progress in anatomy, any more than in cultural anthropology, unless we presume, until the opposite is proved to be the case, that similarity of structure and identity of custom presuppose a common origin. A. K.

The Genera of Fishes from Linnaeus to Cuvier, 1758–1833, Seventy-Five Years with the Accepted Type of Each. By D. S. Jordan, assisted by B. W. Evermann. Pp. 161. (Leland Stanford Junior University Publications: University Series.) (California: Stanford University, 1917.)

THE aim of this list, which must have involved much labour, is "to give stability to nomenclature" by altering, for the sake of priority under new rules enacted by various committees the mission of which thus to revolutionise has never received general sanction, most of the names with which we are familiar and the change of which would defeat the very object for which the use of Latin names is intended. We are glad botanists have almost unanimously repudiated such suggestions, and we trust to the good sense of the zoologists of the future to treat in like manner these attempts at upsetting nomenclature, and thus adding to the difficulties not only of systematics, but, even more, of every other department of biology. The writer of this notice is determined to continue, as in the past, to respect old names which have been universally in use, even if they do not conform to the strict rule of priority, which should be applied only when no serious harm can result from the point of view of stability in nomenclature.

We are referred to a Committee of Zoological Nomenclature, including several Germans, in May, 1917 (*sic*), with an appeal for "the fullest criticism both as to matters of fact and of opinion before placing the contents of this paper before the International Commission." We doubt if a commission so composed will ever meet again, and such seems to be also the impression of its president, as conveyed in the address delivered by him to the Zoological Society of France in January, 1915. G. A. BOULENGER.

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 Promotion of a Closer Union between England and Italy.

THE utility, even the necessity, of a more intimate union between the democracies of the Entente will make itself felt still more urgently after the war than it does now. After the war, in fact, and even if its issues be as we wish and firmly trust they will be, there certainly will still be the danger that the hegemonic aspirations of Germany will again arise, and that she will renew her attempts at economic, technical, and scientific penetration for political purposes. On the other hand, the international division of labour, and the necessity arising from it that each country should avail itself of the complementary production and work of the other countries, will certainly continue after the war; so that, if this division of labour among the countries of the Entente is not organised, and if there does not come to pass a closer intellectual and moral union between Britain, France, and Italy, the last-named country sooner or later cannot but have recourse again, and in large measure, to Germany for all those productions and services needed to complete her own.

It is not enough, however, that Britain will produce henceforth all those manufactures which we formerly imported from Germany; nor will it be enough that she can furnish them at prices so low as to compete with Germany; nor yet will it be enough that the British manufacturers will understand the necessity of furnishing all those large supplies of goods on credit and affording all those facilities in the way of long credit with which Germany coaxed our markets. Certainly all these are measures that Britain must adopt immediately if she wishes to regain this market. If formerly, when she was the only producer of given machines or goods, she might well expect the customers spontaneously to come to her without needing to give herself too much trouble to secure them, now that she has a competitor so dangerous as Germany, Britain, too, must take due pains to acquire and preserve in our country an ever-widening circle of customers.

But, I repeat, even all these facilities will not suffice. For the economic penetration of one country by another must always be accompanied, and often even preceded, as Germany well understood, by a whole process of intellectual and moral penetration.

Let not the fact, for instance, seem insignificant that while almost no British firm is accustomed to write in Italian to Italian customers, the Germans, on the contrary, did so in always increasing measure. It is but too well known how they studied our needs and tastes in order to satisfy them. The insinuating work, often undignified, but persistent and able, of their commercial travellers has been remarked by all as one of the most important means used for the conquest that they had made in a few years of the world's markets in general, and of ours in particular.

As regards the intellectual side, properly speaking, no one can fail to recognise what valuable arms for Germany's penetration here among us in Italy she had in her books and periodicals, especially scientific and technical. These books and periodicals were in course of time considered so necessary to the students both of technical high schools and universities that where, in our secondary schools, there was the option between English and German, a proportion always greater from year to year chose the latter. Our future technical and scientific men thus completed their instruction with German books and periodicals; and when their studies were finished, and they entered the great arena of industrial and scientific life, the influence of this intellectual training, to a great extent of the German stamp, had its after-effects on all the scientific, technical, and economic relations of our country with Germany.

It is, therefore, necessary that Britain, throwing aside not only in politics, but also in all the varied forms of international relations, its proud device of "splendid isolation," should understand the full necessity of this reciprocal moral and intellectual penetration of our two countries, and convince herself that no efforts to produce and intensify it can ever be great enough.

I should be glad, for example, to see that in the British commercial schools Italian commercial correspondence should be taught; that the principal industrial and commercial firms in Britain should meanwhile, as soon as the war is over, call for Italian young men to conduct their correspondence with Italy in Italian; and that an ever-increasing number of British young men should be sent every year to Italy —whether to our commercial schools and commercial universities or to our largest industrial, commercial, and banking houses—to exercise themselves in Italian and to know better the economic life of our country. Both in Britain and in Italy special sections of the respective commercial schools and commercial universities should be devoted to the preparation of commercial travellers and agents, perhaps also commercial consular officials, through the careful study of the commercial and industrial needs of each country.

Then it would be of fundamental importance, as we have just now said, to see to the reciprocal penetration of a technical and intellectual sort. The exchange of teachers and students in the universities and other superior schools, which will no doubt have been already thought of, will aid this not a little. Very useful also in this regard will be the establishment, not only in Milan and London, but in all the principal cities of Britain and Italy, of Italo-British institutes. And no less is it to be recommended that British books should be more largely bought by the public Italian libraries, and Italian books by British libraries; and that in every important city in Britain and Italy should be formed associations of the studious, the technical men, the manufacturers, for the purpose of founding reading-rooms, in which would be found all the important foreign reviews—scientific, technical, economic, legal, political, historical, literary, artistic, and so on.

But all this would certainly be not yet sufficient. If Britain wishes to regain in other countries for its book production, both technical and scientific, the place from which Germany was gradually ousting her, her authors must no longer assume a point of view too strictly or exclusively British, but must "internationalise" themselves more, as precisely the Germans did. It is necessary, in other words, that the British books and periodicals, both technical and scientific, should look more frequently than they do now to see what is being done and thought outside their own country; that due account should be taken of this in order to get out of that isolation from the rest of the world which is such a hindrance to their diffusion in the countries that are not Anglo-Saxon; that they should take more care to divest themselves of their exotic appearance, which to us Latins is more marked in them than in the book production of any other country, derived from archaic systems and methods, such as their systems of measure and the like, which have hitherto disdained to give place to systems and methods now become international.

At the same time, British publishers might be asked to give more attention, and on broader lines, to advertising their books in the countries not Anglo-Saxon. Let me be allowed to quote in this connection a typical fact, drawn from my personal experience. In the first years of existence of the international review *Scientia*, of which I have the honour to be editor, no one would believe the difficulties we met in obtaining gratis from British publishers their books for which we asked in order to review them; while the German publishers hastened to send us works costing as much as forty, sixty, or more marks, and after our first request continued sending books of their own accord, many British publishers answered us, even with regard to works costing only 5*s*. or 10*s*., that the greatest concession they could make us was to let us have them at half-price. The result was, of course, that in the early days of *Scientia* the German works reviewed in it were three or four times as many as the British, and certainly through no fault of ours.

Then courageous publishers, or publishing trusts formed for the purpose, ought to put out in Britain English translations of Italian technical and scientific works, and in Italy Italian translations of works in English. The British public must, in fact, cease to appreciate only what is British, and become convinced that in other countries there may be something good which deserves to be known. In this connection the fact is significant that before the war our review above-named had in Germany a circulation four or five times larger than it had in Britain. It was a sign that the German public recognised more than the British public the utility and interest there was in following attentively the international movement of ideas, and appreciated more the scientific production of other countries.

But a measure which we consider would be of more avail than any other to effectuate this closer moral and intellectual union between Britain and Italy, and in general between all the peoples of the Entente, is that already advocated by the writer in Italian, French, and British periodicals, and taken into most favourable consideration by all the scientific and political Press of the Allied countries: the establishment, for each of the principal branches of science, of periodicals, international as regard collaboration, but "Ententist" as to editing and publishing—that is to say, scientific periodicals which might fulfil for each branch of science that function which *Scientia* exercises for scientific synthesis in general, embracing, as it does, all the sciences. Here I add that the same thing could and should be done as to technical periodicals relating to each of the principal branches of industry. A periodical, for example, devoted to electrical engineering, or to certain branches of it, jointly edited by the most eminent British, French, and Italian electricians, published by three of the principal publishing firms of the three countries, which would publish articles in the language of the respective authors, but accompanying the text, where this is English or Italian, with the French translation: think how efficacious a work could be done in the way of maintaining in continual mutual contact our engineers and our manufacturers, of making known and introducing in each country the products of the others, of organising in the three countries all the production in that particular branch of industry, of settling and forming the due arrangements for facing German competition. Suppose that such "Ententist" periodicals—perhaps with the financial co-operation of the larger industrial firms in each line, for whom the sum required for the purpose would be but a trifle—sprang up in each of the principal branches of industry and commerce. Who does not see how effective and close a union between our countries of the Entente would in the end be wrought and consolidated by these organs of high industrial control or co-ordination?

In some of the principal industries, therefore, let this first step be taken on the long road still to be travelled. To travel it to the end, once this first step is taken, we shall then be drawn by the shining goal itself that has to be reached: that of the truly intimate union of our two countries, and the federation of the peoples of the Entente on which depend the liberty of the peoples and the peaceful and just re-ordering of the nations.

EUGENIO RIGNANO,
Editor of the International Review *Scientia*.

The Eötvös Revolving Balance.

IN the issue of NATURE for March 21 Prof. Boys directed attention to a very interesting experiment performed by Baron Eötvös, in which the oscillations of a revolving balance were shown to be an effect of the rotation of the earth.

Precise details of the experiment are lacking, but it would appear that the beam of the balance was adjusted so that its centre of mass lay upon its horizontal axis of swing, and that the latter was compelled to revolve in its own horizontal plane with a definite angular velocity. It was observed that oscillations were set up the amplitude of which was limited by the damping resistance of the air.

In the article referred to Prof. Boys gave reasons for thinking that the expression given by Eötvös for the amplitude in terms of the physical constants involved was incorrect, and offered another in its stead. I think, however, that there is little doubt that when the experiment is performed in the way which the published accounts indicate the Eötvös formula is right.

Suppose we take as a system of moving axes of reference principal axes of inertia of the beam of which one coincides with the axis about which the beam swings. Let this be the axis of x, and let it make at the time t an angle ωt with a horizontal line drawn to the west, ω being the angular velocity with which the balance revolves. Let the axis of z make an angle ψ with the vertical; then if Ω is the angular velocity of the earth and λ the latitude of the place of experiment, the angular velocities of the axes are

$$\omega_x = -\Omega \cos\lambda \sin\omega t + \dot{\psi}.$$
$$\omega_y = -\Omega \cos\lambda \cos\omega t \cos\psi + (\Omega \sin\lambda + \omega) \sin\psi.$$
$$\omega_z = \Omega \cos\lambda \cos\omega t \sin\psi + (\Omega \sin\lambda + \omega) \cos\psi.$$

If A, B, C are the corresponding moments of inertia, and if we represent the resistance of the air by a couple $-N\dot{\psi}$, we obtain as the equation for small oscillations of the beam about the horizontal

$$A\ddot{\psi} + N\dot{\psi} + (C-B)\omega^2\psi = (A+C-B)\omega\Omega \cos\lambda \cos\omega t.$$

Assuming the beam to be essentially a long, narrow rod, we may put $B=0$ and $C=A$, and with these simplifications we obtain for ψ the expression

$$2A\Omega \cos\lambda \sin\omega t/N.$$

It is seen at once that the expression is essentially the same as that obtained by Eötvös. The terms representing the free oscillations are omitted, as such oscillations will ultimately be damped out by the resistance of the air. In simplifying the equation, the assumption is made that $A\Omega$ is small compared with N. It seems probable that Eötvös used a "small" balance in order to ensure that this condition should be satisfied, for if we compare similar balances $N \propto L^4$ and $A \propto L^5$, where L denotes a linear dimension. If this condition were not satisfied, the character of the motion would be considerably modified.

J. B. DALE.

King's College, June 12.

I HAVE to thank Prof. Dale for pointing out the very serious error that I made when I assumed that the variation of centrifugal force was the only action operative in the Eötvös revolving balance, and I must apologise to Mr. Korda for having treated his account of this beautiful device as inaccurate as well as inadequate.

C. V. BOYS.

The Discovery of the New Star in Aquila.

CAPT. E. V. PIPER, of Fowey, Cornwall, was observing meteors on the night of June 7–8 between 12h. 30m. and 13h. 0m. G.M.T., and saw seven. He recorded a 1st mag. one at 12h. 45m., which shot to just below Altair from a little above a bright star to the west which he could not identify. This star had a green tinge, and was equal in lustre to Altair. Though he knew the constellations and all the brighter stars in this region very well, he was struck with the strange object to the right of Altair. Mrs. Piper, who came out on the balcony from which Capt. Piper was observing, also remarked on the green colour and flashing light of the star.

Capt. Piper saw the star again on the evening of June 8 at 9.18 p.m., and was puzzled at its appearance, but considered that it meant some phenomenon already well known to astronomers. On Monday, June 10, he saw an announcement in the newspapers that a new star had been discovered in the position where the strange object had attracted his notice on the morning of June 8.

The whole of the facts and circumstances of the observation have been investigated by Mr. T. H. L. Hony, of Fowey, who is an amateur astronomer, and is convinced of the perfect trustworthiness of the details.

Capt. Piper has occasionally sent me accounts of meteors, and they have been very good. It seems to me that the difficult feature to understand in connection with the observation of the star on the morning of June 8 is that it was as bright as on the following night. We know that these objects rise very rapidly to a maximum. The Perseid nova of February, 1901, increased from less than 12th magnitude on February 20 to 2·7 magnitude on February 21 after an interval of twenty-eight hours!

W. F. DENNING.

Bristol, June 18.

The Food of the Rook.

THERE is still so much difference of opinion among those who, like the writer of the note in NATURE of June 6 (p. 271), have examined the contents of the stomachs of rooks as to the economic position of these birds that the time has come when a committee of scientific men should be invited to sift the extensive evidence that is now available and issue a report.

I am in agreement with Dr. Long that the method of balancing one grain of corn as beneficial against one insect as injurious is most fallacious. The corn found in the stomachs of rooks in the summer months (May and June), and a great deal of the corn gathered by the rooks on the roadside or after gleaning in the autumn, would never be garnered by the farmer, but an injurious insect that escapes the visitations of the birds is always capable of considerable mischief.

The case against the rook is not yet proven, but the evidence should be collected together and submitted to the consideration of a scientific jury.

SYDNEY J. HICKSON.

The University, Manchester, June 22.

DR. LONG (NATURE, June 20, p. 304) raises a point which I think must appeal to many. The potential damage, represented by the 23·9 per cent. of injurious insects, is surely the one factor upon which everything depends; and, difficult though it is to see just how the necessary information is to be acquired, we are scarcely justified, so I am inclined to think, in arriving at any conclusion without it.

Is it not a fact that the Hungarian Central Office for Ornithology reached the conclusion, after careful investigation, that the rook is of service both to agriculture and to cattle-breeding?

H. ELIOT HOWARD.

Hartlebury, June 22.

"Harbour Engineering."

LEST it should be assumed that I tacitly acquiesce in certain sins of omission alleged in the review of the second edition of the above book, which appeared in NATURE of June 13, may I point out that the matters in question (slipway construction, durability of concrete in sea-water, mechanical handling of material, etc.) are discussed so fully in the companion volume on "Dock Engineering," to which they are equally, if not more, appropriate, that it seemed undesirable to include any extended notice of them in "Harbour Engineering"? Reference to this fact is to be found in several places (pp. 147, 265, etc.).

BRYSSON CUNNINGHAM.

June 20.

UNITS AND UNITY.

THE note that appeared in NATURE of March 7 (p. 14) about the nomenclature of temperatures in centigrade degrees measured from a zero 273° below the normal freezing point of water invited further contributions on the subject of units, and other circumstances transform the invitation into an imperative demand. The report of Sir J. J. Thomson's Committee on Science Teaching, without making a definite recommendation for the adoption of metric units, deliberately adjusts its scheme of education in such a way as to make familiarity with metric units a part of general education. What is the use of doing so if metric units are not to be used for the practical affairs of life? Our present situation is ridiculous. Every boy and girl at school who "does science" now learns that metric units are the universal medium of scientific expression, and is practised in their use. At the same time, we cry out for more science in our practical life. What can we expect from our appeal? A boy goes home at the end of term and tells his father that he has been doing science, weighing in grams, measuring lengths in centimetres, pressures in millimetres of mercury, and temperatures in degrees centigrade. Surely the most natural remark for any naturally minded parent to make is that his boy need not pay any attention to that, because, if it had any bearing at all upon practical life, he would certainly have been taught to use pounds or grains, inches, and Fahrenheit degrees, and not the outlandish things that nobody uses after he has left school. There is a story told of Adams, the astronomer, who, in a Swiss hotel, asked for a bath, and was particular that the water should be at 100°. After a long time, the maid came and said she had done her best, but she could not get it above 95°; and I doubt if, even at this day, the President of the Royal Society himself uses the same unit for his bath-water and his water-bath.

If science is to be a part of practical life, the units of science and the units of practical life must be the same. One thing or the other: either practical folk must learn to use metric units, or British men of science must use British units in their laboratory courses. The present divorce between education and practice is ruinous for both. If we want instruments according to metric measures, we get them from instrument-makers who understand such measures, not from those who do not—that is, we tend to get our scientific instruments mostly from abroad—and so on in everything. Hitherto men of science have not cared, because we can use either measure with equal facility, and we take a little pedantic pleasure in being bilingual in that sense. It is the same with our language. We take a tiny pride in the small difficulties of pronunciation that stand in the way of its being a *lingua franca*; we sneer at any attempts to bring spelling into agreement with pronunciation; we advocate the learning of Esperanto or Ido instead, to avoid international jealousy, forsooth. Shakespeare wrote "Gloster," but we lose marks if we do not write "Gloucester"; classical authors wrote "gage," but we must write "gauge," and we chuckle inwardly when our friends write "guage." There is a *ton* of "the high life" in knowing that "C-h-o-l-m-o-n-d-e-l-e-y" is pronounced "Marchbanks" which we are all proud of; and meanwhile English is set down as impossible for the use of the world at large.

The attitude of mild complacency with our own superior knowledge runs through everything. I have heard it said quite recently that meteorology stands in the way of the adoption of metric units. Certainly that is not true of the Meteorological Office. Since May 1, 1914, we have gone a step further than most people in using C.G.S. units for pressure, millimetres for rainfall, metres per second for wind velocity in the Daily Weather Report, and we use absolute temperatures wherever we dare. We have even gone so far as to use milliwatts per square centimetre for solar radiation, instead of the preposterously unscientific unit gram-calories-per-square-centimetre-per-minute. But it is difficult to keep these things going without the support of those who could help. The United States Weather Bureau and the French Meteorological Service, and some others outside, have gone with us. In this country nobody but the Meteorological Office appears to be willing to stand the racket of bringing metric units into practical use.

Some years ago, before the war, I represented to an authoritative committee that for aeronautical purposes a dynamical unit of wind velocity was practically essential, and asked for a judgment between metres per second and feet per second, and was told that "feet per second" was the more appropriate unit. The reason has been voiced for me by one of my own staff—that he himself could manage metric units well enough, but the weaker brethren would understand feet per second better; and for the same reason I find we are drifting back again to miles per hour out of kindness to the less well-informed. The superior person will not look at milliwatts per square centimetre as a unit for solar radiation; people might think he was unacquainted with the literature of the subject.

This supposed consideration for the weaker brethren is a mere will-o'-the-wisp. It is the teacher with years of experience who finds it really hard to change his habit. Well-meaning people tell me that atmospheric pressure expressed in millibars has no meaning for beginners, and there is the same tendency to slip back, into inches, because, forsooth, people will understand them better. The supposed simplicity is quite fallacious. The majority of mankind who use barometers do not understand pressure measured in inches; in fact, they have never thought about pressure at all, but simply about barometric readings, which are another matter. From the foundation of the Meteorological Department of the Board of Trade in 1854 millions of barometer readings have been reported to the Meteorological Office from the sea, from ships of the Navy and the mercantile marine; but until reports by wireless were introduced about ten years ago, so far as I know, not a single barometric pressure—only the raw materials for getting it. And the result of requiring pressure instead of readings in the wireless telegrams was as instructive for the observer as it was for the office. Under the old plan the observer read the barometer; it was marked in inches, but did not read in inches, of course; he gave the number of the barometer, so that we might look out its index error, and the reading of the attached thermometer, so that we might get the correction, and some clerk in the office had to make out the pressure. It is to be noted that in meteorology the difference between the first reading and the pressure is not a mere trifle, but sometimes more than the differences of pressure which we map. After these sixty-four years of reading barometers without knowing the meaning of what was read, some jolt is necessary to persuade people to understand what we really mean, not in theory, but in actual working practice, by the pressure of the atmosphere; and the use of a real pressure unit is by far the best form of jolt. When the Israelites crossed the Jordan they were ordered to set up a pillar of stones so that their posterity might ask the question, "What mean ye by these stones?" And so the question, "What mean ye by millibars?" is the first step in the enlightenment of many practical men about the realities of atmospheric pressure in meteorology. And, strange as it may seem, our marine observers, who are practical men, are not in the least unwilling to regard the innovation in that light. No objection to the change has come from them. What other and more ordinary educational institutions think about it I have never heard; they have probably not considered it at all. It is, of course, deplorable that there are so few people within reach of any inquirer who can give him the answer to the question that leads to enlightenment; but that is another story.

So with temperature: the schools and universities use the Centigrade scale and zero. I defy anybody who is used to the practical convenience for meteorological purposes of the Fahrenheit scale to face the change to the Centigrade scale and zero, which would flood our tables with negative quantities, without asking himself: "What means this zero?" And if he does ask himself the question he must realise that, besides avoiding for ever negative values in meteorological work of every kind, the adoption of the so-called absolute scale sets up a pillar round which much information of the utmost interest and importance is twined. The expansion of gases, the transformation of heat into work, the radiation into open space, all depend upon the absolute temperature, which, therefore, has some reality about it. There may be small discrepancies, as Prof. Marvin has pointed out; but they are not of the first order. In these days, when temperature is of real significance in all sorts of ways, I cannot imagine how a teacher has the courage to face a pupil with a negative temperature, and to go on doing it seems to me to be either inveterate habit or simple obscurantism. And yet I find, now that flying men are beginning to record temperatures in the upper air, they are on the way to give us negative temperatures on the Fahrenheit scale because (I suppose) they understand them! To me the practice appears to be based, not on thought, but on simple thoughtlessness.

There is a time for everything, and the present seems to be the time for a change of units. Take, for example, the decimalising of our coinage. Let it be granted that we cannot change the pound because that would mean translating all the recorded values from the time of the introduction of the sovereign. To change the shillings and pence into decimals is, from that point of view, a small matter. The stumbling-block has always been the penny, because there were so many hundreds of millions of things sold for a penny that a change in the penny would ruin either the traders or their customers. But now the penny has lost all its significance; everybody wants it changed. A penny paper is seeking a new price; it costs three halfpence or twopence or threepence; a penny stamp now costs three halfpence. Why does not the Chancellor of the Exchequer put stamps in terms of hundredths of a pound? The opportunity is a golden one for the nation, and incidentally for the Exchequer because any unconsidered fractional difference might go there.

It is time for those who think that a unified system of measurement is worth having to make a push for it. It is scarcely likely that, to the open mind, there can be any real difference of opinion as to the units which should be chosen. It is one of the truisms of science that the same reasoning always leads to the same conclusion. All the traditional obstacles have disappeared, and, above all things, we want to get on. Another era with the schools and universities using one set of units and all practical people using a different set is almost as deplorable an outlook as peace by negotiation.

NAPIER SHAW.

PROF. H. G. PLIMMER, F.R.S.

BIOLOGICAL and medical science has sustained a great loss by the passing away of Henry George Plimmer on Saturday last, June 22. Plimmer had contributed much by his writing and influence to comparative pathology during his life, and his last illness interrupted a valuable and strenuous research on trench fever. During his earlier years he prepared himself for a scientific career by visiting and working with the great pioneers of that time, and it was doubtless owing to the influence of men like Pasteur that the direction of much of his subsequent research was due. He always kept up his Continental interests, and often took part in the proceedings of foreign scientific congresses.

For many years Plimmer was connected with the Royal College of Surgeons and with the Zoological Gardens, which afforded him great opportunities for investigating pathological problems. About three years ago he was appointed to the chair of comparative pathology at the Imperial College of Science and Technology, which had been founded by the munificence of an anonymous donor.

The scientific, as well as the sterling human, qualities of Plimmer found abundant opportunity in his new post. His lectures were eagerly attended by a large body of students, and as this attendance was quite voluntary, it is no small tribute to his genius that the room was often crowded, even to overflowing. Gifted with an unassuming and sympathetic nature, as well as possessed of a knowledge of the world, his help and advice were often sought by those in trouble or difficulty, and many a young man would readily acknowledge the debt owing to his kindly help and wise counsel.

Plimmer was a fellow of the Royal Society, as well as of many other learned societies, both at home and abroad, and his contributions to science are scattered through their Proceedings and Transactions. He was an accomplished microscopist, and his presidential address to the Royal Microscopical Society is a model of critical and scholarly research.

This is, however, neither the time nor the place to attempt a full account of his scientific labours. That must come later. But Plimmer's interests were not restricted to the pursuit of science. Endowed with many and varied gifts (he was, for example, a musician of the very first rank), it was often a matter of surprise to many of his friends that he could have possibly found time and opportunity to develop and excel in them as he actually did.

It is hard to speak of Plimmer as a friend in sufficiently measured terms, and those who knew him best are best able to appreciate the rare qualities of the man. Partly Stoic, partly Epicurean, and largely something wholly his own, he was a delightful companion. Added to a philosophical and discriminating enjoyment of the best that life has to offer, his loyal and unselfish nature endeared him to a wide circle of devotedly attached friends. Perhaps the most that can be said of any man is that the world is a better place for his having lived in it, and this is emphatically true of Plimmer.

J. B. F.

DR. E. A. NEWELL ARBER.

THE death of Dr. Newell Arber, on June 14, in his forty-eighth year, after a long illness, adds another name to the already long list of palæobotanists whose obituary notices have appeared in these columns during the last two or three years. After taking his degree at Cambridge, Arber was appointed university demonstrator in palæobotany in 1899, a post which he held at the time of his death. He devoted himself heart and soul to the study of fossil plants both by his own researches, extending over a wide field, and by his ever willing help to the students whom he taught: through his energy a large number of fossil plants were added to the Sedgwick Museum, and the well-arranged and carefully named collections bear witness to his methodical and careful curatorship. In 1909 he married Miss Agnes Robertson, an accomplished botanist, who has recently been re-elected to a fellowship at Newnham College.

In addition to numerous papers, Arber published four books: a British Museum Catalogue of the Plants of the Glossopteris Flora (1905), a work which is much more than a compilation and is indispensable to palæobotanical and geological students; "Plant Life in Alpine Switzerland" (1910); a volume on the coast scenery of North Devon (1911); and a very useful book on coal, one of the "Cambridge Manuals," which has been translated into Russian. Much of his original work was concerned with British Carboniferous plants: he by no means confined himself to collecting and describing specimens, but made valuable contributions to the stratigraphical problems connected with the floras. He was particularly interested in the Kent coalfield and added considerably to our knowledge of the floras of the Forest of Wyre, the Forest of Dean, and other coalfields. He published papers on the anatomy of Sigillaria, in collaboration with Hamshaw Thomas, Medul-

NO. 2539, VOL. 101]

losa, Lyginopteris, Cupressinoxylon, Dadoxylon, and other genera. A memoir, published this year, on the earlier Mesozoic floras of New Zealand, an extension of a shorter paper read to the Royal Society, is an especially valuable addition to our knowledge of a much neglected subject. Two papers written in collaboration with his friend Major Parkin, on the origin and evolution of the Angiosperms, afford evidence of Arber's power of treating in a philosophical spirit difficult and controversial problems. Among other papers, mention may be made of one on the past history of ferns, and of those on Glossopteris, in which the sporangia are described for the first time, Lagenostoma, Psygmophyllum, Yuccites, Zamites, and Pterophyllum.

Arber had made for himself a name as an authority on the economic side of palæobotany, primarily in connection with the Kent coalfield. It is impossible, in a short article, to give an adequate account of his original work; his output was much greater than that of most men of his years, and, in view of the difficulties with which he had to contend, the amount he was able to accomplish compels our admiration. Arber was a man of strong convictions and had the courage of his opinions; he was unsparing of himself in his devotion to the science which he loved and to the service of his university. Those who knew him well felt for him a deep affection and can most sincerely share the grief of his devoted wife, with whom he enjoyed a true companionship of heart and work.

A. C. SEWARD.

NOTES.

THE Board of Trade has appointed, with the concurrence of the Ministry of Reconstruction, a Committee to examine and report upon the water-power resources of the United Kingdom and the extent to which they can be made available for industrial purposes. The members of the Committee are:—Sir John F. C. Snell (chairman), Mr. G. S. Albright, Sir Dugald Clerk, F.R.S., Dr. J. F. Crowley, Mr. H. F. Carlill, Mr. P. Dawson, Prof. A. H. Gibson, Mr. V. Hartshorn, J.P., Dr. H. R. Mill, Mr. A. Newlands, Mr. G. C. Vyle, Mr. A. J. Walter, Mr. Ralph Walter (Ministry of Reconstruction), and Mr. D. J. Williams. Mr. R. T. G. French is the secretary, and all communications intended for the Committee should be addressed to him at 10 Princes Street, Westminster, S.W.1.

THE twenty-ninth annual meeting of the Museums Association will be held at Manchester on July 9–11 under the presidency of Mr. E. Rimbault Dibdin. Among the subjects to be discussed are:—"The Museum in Relation to Art and Industry," H. Cadness; "The Application of Art to Industry and its Relation to Museum Work," S. E. Harrison; "The Museum and Trade," T. Midgley; and "Arrangement of an Ethnographical Collection," B. H. Mullen.

AT the annual meeting of the American Institute of Electrical Engineers, held last month, Col. J. J. Carty, U.S. Signal Corps, was presented with the Edison medal of the institute in recognition of his services in developing the science and art of telephone engineering.

WE regret to note that the death of Mr. John H. Heck is recorded in *Engineering* for June 21. Mr. Heck was senior engineering surveyor to Lloyd's Register of Shipping in the Glasgow district, and was sixty-seven years of age. He read many papers on engineering subjects before the Institution of Naval Architects, the North-East Coast Institution of Engineers and Shipbuilders, and other technical societies.

THE death is announced in his forty-ninth year of Dr. C. C. Trowbridge, assistant professor of physics at Columbia University, New York. Dr. Trowbridge had made notable contributions to the knowledge of meteors and of the mechanics of bird-flight One of his principal services to Columbia University was his development of the E. K. Adams precision laboratory, one of the best-planned and best-equipped laboratories in America.

THE registrar of the Institute of Chemistry has received a letter from the Board of Education stating that the Ministry of National Service has cancelled the arrangements made in connection with military service to students of chemistry. The effect of this cancellation is that any student of chemistry in Category B (i), C (i), or B (ii), or in Grade 2, who has hitherto been protected under the arrangements in question will be called up, if otherwise available for service.

WE learn from the *Lancet* that Prof. S. J. Pozzi, professor of clinical gynæcology in the University of Paris, was fatally shot on June 13 in his consulting-room in Paris by a lunatic patient. Prof. Pozzi was born at Bergerac (Dordogne) in 1846. He was educated at the lycées of Pau and Bordeaux, becoming a student of medicine in Paris in 1869, where he was an apt pupil of Paul Broca. From 1885 to 1894 he acted as secretary-general of the French Congress of Surgery, and in 1895 was elected to the Academy of Medicine. He was an honorary fellow of the Royal College of Surgeons of England and an officer of the Legion of Honour.

THE council of the Royal Society of Arts announces that the next award of the Swiney prize will be in January, 1919. Dr. Swiney died in 1844, and in his will he left the sum of 5000*l*. Consols to the society, for the purpose of presenting a prize, on every fifth anniversary of his death, to the author of the best published work on jurisprudence. The prize is a cup, value 100*l*., and money to the same amount. The award is made jointly by the Royal Society of Arts and the Royal College of Physicians, and is given alternately for works on medical and on general jurisprudence. On the last occasion of the award, in 1914, the prize was awarded for general jurisprudence. It will, therefore, be offered on the present occasion for medical jurisprudence.

ONE of the tasks of the General Staff at the War Office during the war has been the issue of a *Daily Review of the Foreign Press*, the scope of which has been extended from time to time by the preparation of supplements dealing with special subjects. A fortnightly Technical Supplement, compiled with the cooperation of the Institution of Civil Engineers, was added to the list in January last, and since then has been widely circulated through official channels for the assistance of naval and military workers. We are now informed that it has been decided to place the Technical Supplement on sale, and the issues of May 28 and subsequent numbers may be obtained at the cost of sixpence through any bookseller or directly from H.M. Stationery Office at Imperial House, Kingsway, London, W.C.2.

THE council of the Institution of Electrical Engineers is prepared to receive papers on the subject of "The Co-ordination of Research in Works and Laboratories," with a view to the paper being read and discussed at one of the ordinary meetings of the institution in London, and also before one or more of the local sections. Papers should not exceed 15,000 to 20,000 words in length, and the council will award a special premium of 25*l*. to the author of the paper which best fulfils the objects of the discussion, provided such paper reaches the standard aimed at by the council. Papers should be sent to the secretary of the institution not later than November 4 next. It is the intention of the council to publish the selected paper (which will become the property of the institution) in the Journal, together with the discussion. Competitors intending to submit papers are invited to communicate with the secretary.

THE latest part of the *Geologische Rundschau* (April, 1918) contains much news of geology and allied sciences in Germany and Austria. Prof. W. Branca has retired from his professorship in Berlin, and has been succeeded by Prof. J. Pompecki, of Tübingen. Prof. E. Kayser has similarly retired in Marburg, and his successor is Prof. R. Wedekind. Prof. L. Milch, of Greifswald, has followed the late Prof. Hintze as professor of mineralogy in Breslau, and Prof. E. Hennig, of Berlin, has become professor of geology at Tübingen. Prof. O. Abel has been made ordinary professor of palæobiology in Vienna. The long list of courses of lectures in the universities during the winter semester 1917–18 includes not only the usual general subjects, but also many special subjects in preparation for research. Among these may be mentioned the atomic structure of crystals, the science of gem-stones, alpine geology, palæontology of mollusca, of fishes, amphibia, and reptilia, evolution of the mammalia, the Ice age and early man, and the principles of palæobotany. There are a few technical lectures on coal and petroleum, on the geology of Germany, and also one course at the Colonial Institute at Hamburg on "The Geological Conditions of the German Protectorates." An appreciative obituary notice of Prof. E. W. Benecke, who died at Strasburg on March 6, 1917, aged seventy-nine, is accompanied by a fine portrait.

MR. T. T. WATERMAN gives a full history of the Yana group of Indians in North-eastern California in the University of California Publications in American Ethnology and Archæology (vol. xiii., No. 2, February). They are distinguished from their neighbours not so much by physique and culture as by language. They are important because, for certain rather extraordinary reasons, a few members of the group remained conservative much longer than the other Indians in California, retaining their primitive mode of life in a very unusual degree until 1908.

THE REV. S. S. DORMAN discusses native ideas of cosmology in the *South African Journal of Science* (vol. xiv., No. 4, November, 1917). The origin of these is obscure, but the writer remarks that the Abenanswa may be a mixed remnant of the old Hamitic stock; Semite and Hamite are very closely related both in blood and language, and very probably had the same or similar legends of Creation. If so, the Abenanswa, like the Masai, could have derived their legends from the north, and the Bantu may have learned them in a more or less complete form. But, on the whole, the writer leans to the conclusion that the Bantu ideas of cosmology are purely their own, and are thus an index of the mentality of that race.

IN an interesting article entitled "Some Early Artists of Gloucester," published in vol. xl. of the Transactions of the Bristol and Gloucestershire Archæological Society for 1917, Mr. St. Clair Baddeley discusses the so-called Roman walls of the city. None of the earlier historians—Æthelwerd, Fosbroke, or Atkins—record any tradition of such walls. They were not discovered during the excavations of 1818, nor during the Shire Hall extension in 1909, and it seems clear that Romano-British Glevum never had anything more substantial than the powerful fosse and vallum of other Roman settlements. The remains shown as "Roman" walls are not Romano-British; they are entirely medieval, though probably occupying the convenient line of the Romano-British fosse, and it seems clear that the small Romano-British Glevum, having in its rear the Severn, had no need of elaborate defences. The walls belong to the Norman period when Gloucester became an outpost, like Chester, to guard the country from the incursions of Welsh horsemen.

MESSRS. HEADLEY BROS. have sent us two "Papers for the Present," namely, (1) "The Modern Midas," (2) "The Banker's Part in Reconstruction," published by them for the Cities Committee of the Sociological Society. These two papers are the first of a series on economic and social problems intended to educate public opinion in the direction of certain schemes of reconstruction. Their object is to reverse the tendency to centralisation and bureaucracy, in which Germany set a bad example to Western civilisation, and to substitute for it local and spontaneous action in every sphere of life, social, political, and economic. This is combined with an insistence on communal rights, the two objects being reconciled in the maxim, "Individualise the State, socialise the Community." The two papers under notice cover the financial side of this policy. They advocate the conscription of incomes for the period of the war, the nationalisation of credit and of the credit machinery, and the use of the latter for promoting production after the war on lines profitable to the community and beneficial to the worker. On the negative side, the two chief objects of attack are the gold standard and the anti-social powers of modern finance in private hands.

WE have received from the Carnegie Institution of Washington a volume entitled "European Treaties bearing on the History of the United States and its Dependencies to 1648." It is edited by Mr. F. G. Davenport, and contains the original texts, with translations and notes, of forty treaties and Papal Bulls, which all deal with the struggle for participation in trade and territorial possession of the lands newly discovered in the fifteenth and sixteenth centuries. The originals of these documents are difficult of access, particularly to the American student, so the present collection should prove very useful. While mainly of historical value, there is much in the early documents of geographical interest. Spanish dominion in the West and Portuguese dominion in Africa and the East were prompted by the Papal Bull of 1493, assigning to Castile the exclusive right to lands west of the meridian situated 100 leagues west of the Azores, lands discovered before Christmas, 1492, to be excepted. A later treaty pushed this line to 370 leagues west of the Cape Verde Islands, and both Portugal and Castile agreed to send caravels with pilots and astrologers to determine the location of the line. But this demarcation never took effect. The confusion caused in territorial rights in the Moluccas by the Pope's failure to extend his line to the further side of the globe is illustrated in later treaties. This confusion had been intensified by the

Bull of 1514, giving Portugal the rights to all lands discovered by her in her voyages to the East irrespective of their longitude. The gradual settlement of these questions is traced in later treaties.

SOME valuable medical studies are in course of publication by the Leland Stanford Junior University, California. Of these we have received "Bone and Joint Studies," by Profs. Leonard W. Ely and J. F. Cowan, and "The Pathology of Nephritis," by Prof. W. Ophüls. In the latter it is considered that many forms of inflammation of the kidney are due to bacterial infections, commonly streptococcal.

ROCKY MOUNTAIN spotted fever is a typhus-like disease occurring in limited tracts of country adjacent to the Rocky Mountains. It is conveyed by the bite of a tick (*Dermacentor andersoni*). Dr. S. B. Wolbach has found present in the endothelium of the blood-vessels a peculiar bacterium which he surmises is the causative organism of the disease (*Journ. Medical Research*, vol. xxiv., 1916, p. 121). He has also found the same organism in infected ticks, but not in ticks proved to be non-infective (*ib.*, vol. xxv., 1916, p. 147). Further studies show that the characteristic lesions of the disease in man are practically restricted to the blood-vessels of the skin and genitalia (*ib.*, vol. xxvii., 1918, p. 499).

IN the May issue of the Journal of the Board of Agriculture Mr. R. Robson discusses the probable causes of the poor crops of clover seed obtained in Essex last summer. Popular opinion was inclined to ascribe the seed shortage primarily to the dearth of bees, owing to the ravages of the Isle of Wight disease. This might certainly account for the failure of white clover (*Trifolium repens*), since there is a general consensus of opinion that the honey-bee is here the chief pollen-carrier. In the case of red clover (*Trifolium pratense*), however, the predominant *rôle* is played by humble-bees, and there is no clear evidence that their numbers had been sensibly reduced by the disease. An alternative explanation of the small crop is the activity of the very destructive weevil, *Apions apricans* (Herbst), which was extremely prevalent last year. The first-cut clover when stacked was infested with maggots resulting from eggs laid by the weevil in the clover flowers, and within a few days the resulting weevils emerged in myriads from the stacks and proceeded to devour the surrounding clover, and then passed on into the field to lay eggs for the next generation. Every head of clover in which eggs were laid would produce few or no seeds. The weevils move preferably along the ground, and it was found possible to trap large numbers by means of bands of cloth coated with tar and pitch stretched round the stacks, or by means of a trench containing water and tar. The opinion is expressed that the depredations of the weevil were the primary cause of the seed shortage, and farmers are advised to adopt measures to prevent the egress of the second generation of weevils from their stacks of first-cut clover.

NOW that the electro-culture of crops has reached a position of prominence in the public regard, and has even attained the dignity of being invested with a Government Committee, it will probably be a matter of surprise to many that the idea of stimulating plant-growth by means of electricity is more than a hundred and fifty years old. An interesting article in the April issue of *Science Progress* contributed by Messrs. I. Jørgensen and W. Stiles commences with the statement (quoted from Priestley) that the first experiment on the electrification of growing vegetables was made by Mr. Maimbray in 1746. The fact that our present-day knowledge of the subject is but little greater than that of the middle of the eighteenth century is attributed by the authors to the stagnation of the science of the living plant. The vast majority of the researches on electro-culture made since Maimbray's original experiment are on the same lines as the older ones, and give similar results—*i.e.* most show the beneficial influence of electrification, whilst a minority show no such improvement. The physiological investigations in reference to the subject have dealt with the process of assimilation, transpiration, respiration, irritability, and protoplasmic movement in plants, but in no case have the experiments been conducted in such a way as to furnish any information as to the influence of definite electrical conditions on any one of these processes at any definite stage in the history of the plant. The most important work on electro-culture is that of Lemström, who was the first to treat comparatively large areas of land under crops. His work made it clear that the overhead electric discharge will affect the life of the plant in all its phases, and he concluded that the best results are obtained (1) with the network positively charged, (2) by applying the discharge morning and evening, and (3) by having the general conditions favourable to plant-growth. The authors urge that all the investigators have failed to realise (i) the necessity for measuring the discharge, and (ii) that the stimulating effect depending on its intensity and time of application may differ for different stages of the plant's life, and may appear long after it is applied.

THE Bulletin of the Hawaiian Volcano Observatory for February last is noteworthy for two exceptionally impressive illustrations of the surge of lava in the crater of Halemaumau against central crags rising some 70 ft. above it.

THE glacier that occupied the Irish Sea during the maximum extension of Quaternary ice in the British Isles has played a large part in the distribution of superficial materials, and Mr. J. de W. Hinch (*Irish Naturalist*, vol. xxvii., p. 53) gives an excellent review of recent work in the area, and of the evidence which has rendered the hypothesis of an interglacial submergence both untenable and unnecessary.

A NUMBER of substances crystallise from solutions, taking up water of crystallisation. This water is absorbed in molecular quantities, and is generally given up again easily with gentle heating. Little is known as to how the water is bound in the crystal. Investigations on this question are outlined in the *Annalen der Physik* for February 15. A number of different forms of alum are examined, and conclusions are drawn, from spectrum methods, of the structure of the crystals.

A GERMAN firm advertises (*Stahl und Eisen*, February 28) a new air-filter, which is said to be made entirely of iron. The special advantages claimed are:—Great durability and perfect freedom from fire risk; constant resistance (equivalent to from 3 to 4 mm. of water); no oil, grease, or water is employed, the filter being quite dry. There are no running costs for power or attendance, and no spare parts are necessary. Cleaning can be done easily by unskilled workmen. The filter is small in bulk, and can be adapted to the space available. The total capacity of this type delivered or under construction is said to exceed one million cubic metres per hour.

P. SAXL, in the *Gesundheitsingenieur*, describes his investigations on the effect of silver in destroying bacteria in water. It has for a long time been recognised that water that has passed through copper tubes has certain antiseptic properties, and also that metallic silver immersed in the water has an antiseptic action. On this action the author has based the operation of a drinking-water sterilising station. By filling a glass bottle to the brim with water, immersing a silver wire in the bottle so as to reach right down the neck, allowing the bottle to stand for fourteen days, and then pouring out the water, the bottle is found to be left in such a condition that if fresh water is poured in and a silver wire again inserted, the water is rendered germ-free for eight hours. Tests showed that typhoid, cholera, and dysentery bacteria could be destroyed in this way.

In *Science* for April 26 Prof. S. W. Parr, writing upon developments in the chemical industries of the United States resulting from war conditions, refers to the question of potassium supplies, and indicates the progress which has been made towards rendering the States independent of German sources. At present there is much leeway to make up. Whilst more than 40,000 tons of potassium salts will be produced this year, the pre-war imports were nearly seven times this quantity. Nevertheless, recent developments are both interesting and encouraging. The brines of Nebraska and California are just now by far the largest source of available potassium compounds. Next comes the kelp of the Pacific Coast, the utilisation of which is still in the developing stage, but progressing rapidly. More important still are the alunite deposits in Utah, which likewise are being worked, as yet, on a relatively limited scale. "We are also," says Prof. Parr, "just beginning to get glimpses of the possibilities of potassium salts from cement furnaces, from the greensand of the Eastern States, and from the felspars in various localities. At the present rate the potash problem seems in a fair way of solution."

A very interesting lecture delivered before the Chemical Society on February 21 by the Hon. R. J. Strutt on "Active Nitrogen" is reported in the April issue of the Journal of the society. If a stream of rarefied nitrogen passes through a tube in which a vigorous jar discharge is maintained, and then into a second vessel in which there is no discharge, it exhibits a brilliant yellow light in the second vessel. This "after-glow" persists in favourable circumstances for several minutes after the discharge has been shut off. The fact that the luminosity can be maintained only by the passage of the nitrogen from a state of higher to one of lower potential energy would alone suggest the presence of a special form of nitrogen, but this became a certainty when it was found that the gas reacts with gaseous hydrocarbons forming hydrogen cyanide and with metallic vapours giving nitrides. The existence of this "active" nitrogen does not depend on indirect evidence or on obscure spectroscopic phenomena; the hydrogen cyanide can be isolated and identified in the ordinary chemical way. When nitrogen purified by prolonged heating at 300° over sodium is employed the glow is invisible through blue glass, but if oxygen or one of its gaseous compounds (*e.g.* carbonic oxide or dioxide) is introduced into the glowing gas a bluish-violet light is exhibited at the confluence of the two gases. Active nitrogen does not react with hydrogen or oxygen, and the best conditions for its production are a low-pressure and a Leyden jar discharge. Tiede and Domcke were right in asserting that pure nitrogen does not give the phenomenon, but wrong in stating that oxygen is necessary. Other impurities, such as carbonic oxide or dioxide, methane, ethylene, hydrogen sulphide, or mercury vapour, will act equally well.

In a paper published in the *Monthly Weather Review* for December last Prof. R. DeCourcy Ward discusses the subject of "Meteorology and War Flying." The paper is on the usual lines, and points out how important some knowledge of meteorology is to the airman, and how the various elements—pressure, temperature, etc.—influence flying. Perhaps the most interesting part is that relating to clouds and thunderstorms. Prof. Ward states that it is much safer not to fly in a thunderstorm, and then goes on to give instructions as to the best course to pursue when an aviator finds himself hemmed in between enemy country and an advancing storm.

The April part of the Proceedings of the Physical Society of London contains two papers on critical angle refractometers of the Pulfrich type by Mr. J. Guild, of the National Physical Laboratory, and by Mr. F. Simeon, of Messrs. Hilger, respectively, which serve as a good illustration of the way in which improvements in instruments can be effected by co-operation between the makers and the users of the instruments. The critical angle refractometer is the most convenient instrument to use in the determination of the refractive indices of glasses of different compositions, and it has been used at the National Physical Laboratory in the examination of more than two thousand specimens. The experience of the instrument gained in the course of this work is embodied in Mr. Guild's paper, and there seems little doubt that in the near future an instrument will be constructed which will give the absolute refractive index and the dispersion of a specimen of glass to the fifth figure after the decimal place.

An article on the nonius, its origin, theory, and use, by Senhor A. R. Machado, has been published in the *Revista de Quimica pura e aplicada* (Oporto, II. Série, Ano iii., 1918). Being a countryman of Pedro Nunez, the author calls a vernier a nonius, and proceeds to trace the history of this instrument from the book "De crepusculis" by Nunez, published in 1542. In reality, there is no resemblance between the contrivance of Nunez and that of Vernier, published in 1631. Nunez proposed inside the graduated arc of a quadrant to draw concentric arcs and to divide them respectively into 89, 88, 87 . . . 45 equal parts, so that the alidade would always (more or less accurately) touch a division-mark on one of the forty-six circles. Though ingenious, the proposal was anything but a practical one on account of the difficulty of dividing a quadrant into eighty-three or sixty-seven parts. It was improved, though not made much more practical, fifty years later by Curtius, whose idea was published by Clavius. There is nothing new in all this; see, for example, Delambre's "Histoire de l'astronomie moderne," i., p. 253, or Cantor's "Geschichte der Mathematik," ii., p. 580. But no one put a small auxiliary arc on the movable alidade before Vernier. The author of the paper next describes the various uses of the vernier, including Mannheim's double one (vernier de vernier), proposed in the *Journal de Physique,* 1873, to meet the case where none of the divisions of a vernier coincide exactly with a division on the principal scale.

Messrs. *J. and A. Churchill* announce a translation, by G. W. Robinson, of Dr. M. Gina's "Chemical Combination among Metals." In it the relation between chemical composition and physical properties is discussed. The main portion of the book consists of an account of all intermetallic systems in which compounds occur. Messrs. *C. Griffin and Co., Ltd.,* will shortly publish "Simple Experimental Hygiene, Physiology, and Infant Management for the Use of

Teachers," by K. M. Curwen, with an introduction by Dr. G. W. Reid, County Medical Officer of Health and School Medical Officer for Staffordshire. Messrs. *Longmans and Co.* will issue shortly "Canning and Bottling Fruit and Vegetables," by Mrs. Goodrich, with a preface by Prof. F. W. Keeble. The work deals with simple methods of preserving, such as bottling in jam-jars, drying and salting, and with all up-to-date methods of preserving fruit without sugar.

OUR ASTRONOMICAL COLUMN.

THE NEW STAR IN AQUILA.—The new star in Aquila has continued to decrease in brightness at about the same rate as Nova Persei of 1901. On June 21 and 22 it was observed to be about 3rd magnitude, and its reddish colour had become quite pronounced. Prof. Fowler found that the hydrogen lines were still very brilliant on these dates, and that the most remarkable change since June 16 was the appearance of a broad bright band in the blue, about λ 464. The enhanced lines of iron in the green were visible, and also the group of bright and dark lines about the position of D. There was also a dark line near λ 615, which had not been noted in the earlier observations, and the continuous spectrum had diminished in brightness. The principal features of the spectrum were readily observed with a Zöllner star spectroscope on a 3-in. telescope.

Observations of the spectrum of the nova communicated by Mr. Harold Thomson are in general agreement with those of Prof. Fowler, but attention is also directed to a relative brightening of the line λ 532 as compared with that at λ 517.

In the *Times* for June 19 Father Cortie gave a brief account of a remarkable photograph taken with the prismatic camera at Stonyhurst on June 15. The exposure was from 10.35 to 11.35 G.M.T., and the photograph appears as if the spectrum had suddenly changed at about 11.5, and as suddenly returned to its original state about five minutes before the end of the exposure. The modified portion of the spectrum shows a second set of bright hydrogen lines, strongly displaced towards the red sides of the normal lines, which are also present, and an enormous receding velocity would be required to explain the displacements. Prof. Fowler has had an opportunity of examining the photograph, and informs us that there are certain features which suggest that an explanation may be found in an instrumental displacement. Apart from this, however, the photograph is a valuable record of the spectrum on the date in question. The bright hydrogen lines consist of three or more components, and there are numerous ill-defined fainter lines, besides several apparent dark lines. The chief features appear to be generally similar to those of Nova Persei at a corresponding phase.

DISCOVERY OF A COMET.—The first cometary discovery of the year was made by Mr. Reid at the Cape of Good Hope. It appears as a faint round nebulosity, and is moving south 48′ daily. Its position, June 12·25 G.M.T., was R.A. 9h. 16m. 36s., S. decl. 8° 10′. It is invisible in northern latitudes, setting shortly after sunset.

BULLETINS OF THE HECTOR OBSERVATORY, N.Z.—From recent bulletins of the Hector Observatory, Wellington, N.Z., it would appear that the Government astronomer, Mr. C. E. Adams, is endeavouring to make the institution as useful as possible to the general public. Bulletin No. 10 gives tables of the rising, meridian passage, and setting of the moon during the present year at places on the standard meridian (12h. east of Greenwich) in south latitudes 35°, 40°, and 45°, and it is shown by examples how the times for other places may be obtained by interpolation. The latest arrangements adopted for the time service are explained in Bulletin No. 11. The standard mean-time clock has been fitted with contacts, by which signals are given at the beginning of every hour of G.M.T., and repeated after the lapse of 1, 2, 4, and 5 minutes in each case. A similar system is adopted in connection with the wireless signal sent out at 22h. G.M.T. Another bulletin, issued in February, gives particulars of the occultation of a 6th magnitude star by Venus on March 3, according to calculations made by Pte. Arthur Burnet, secretary of the Leeds Astronomical Society.

THE BRITISH SCIENCE GUILD.

THE twelfth annual meeting of the British Science Guild was held at the Mansion House on June 19, the Lord Mayor presiding. The adoption of the annual report was moved by Prof. R. A. Gregory, and seconded by Sir Edward Brabrook. After alluding to the loss sustained by the guild in the death of Sir Alexander Pedler, for many years hon. secretary, Prof. Gregory gave a summary of the work of the various committees on education, the metric system, and the dyes industry. The last-named emphasised the strong financial support given to the German dye industry, aggregating more than 50,000,000*l.*, whereas the total capital of the colour-producing firms in the United Kingdom is only about four millions. In this country the chief need is to survey the great variety of products under manufacture, allocating the work in such a way as to avoid duplication of plant and effort. Reference is made in the report to the British Scientific Products Exhibition to be held at King's College, London, for four weeks during August–September. It is hoped that the exhibition will be helpful in illustrating the need for scientific research in relation to various arts and industries, and the results already achieved in this country in this direction since the war.

After the adoption of the report, an address was given by Lord Sydenham, the president of the guild, on "Education, Science, and Leadership." Our projects of national reconstruction, it was remarked, tend to accentuate industrial and commercial efficiency. But there are other problems the solution of which will require an enlightened democracy and instructed leadership. Our education, besides aiming at material efficiency, must inspire ideals. Lord Sydenham showed, from data relating to universities in this country, in Germany, and in America, that facilities for higher education are still not what they should be. At present only one child in a thousand from the elementary schools reaches a university. National education should provide equal chances for natural talent wherever found.

A paper by Sir Algernon Firth was read, in the absence of the author, by Sir Ronald Ross. The author sought to dispel the impression that manufacturers were not sufficiently alive to the need for research work in their industries, and quoted from the reports of a Board of Trade Sub-Committee to show the efforts being made to bring this matter before the notice of the authorities. Industries were not infrequently hampered owing to lack of knowledge in Government departments. For example, the growth of the dye industry was checked at the start by the refusal of duty-free alcohol. Besides developing facilities for research, it was necessary to provide inducements for youth to make use of them. In this respect we might learn from the enlightened attitude towards college education prevalent in the United States.

Sir Henry Newbolt, who followed, likewise emphasised the vital importance of true education, both of the mind and of character, to the future of this country. It might be true that science had not yet received the centuries of devoted effort bestowed on the humanistic studies, and was in process of development. But ultimately the impression that there was any antagonism between humanistic and scientific study would disappear. In both cases there was a search after truth and a similarity in general aims, and both demanded gifts in the teacher not only of intellect, but also of character.

A vote of thanks to the Lord Mayor and speakers was moved by Sir William Beale, and this terminated the proceedings.

THE IMPORTANCE OF THE NON-METALLIC INCLUSIONS IN STEEL.

IT is impossible to manufacture steel which does not contain non-metallic inclusions to a greater or less extent. These have an important effect on its properties, particularly in producing defects and causing failures to a degree which is not sufficiently realised. Mr. A. McCance, who presented a most able study of this subject at the May meeting of the Iron and Steel Institute, states that much defective steel is bad solely because of the number of non-metallic particles which it contains, and that fully 90 per cent. of the failures due to faulty material which have come under his notice are traceable to this cause alone. He states further that when material has cracked under a stress which experience shows it should safely have carried, it is advisable to examine the crack along its whole length, and when this is done, in many cases it will be found that the crack passes through groups of inclusions, while in cases in which it can be traced to its origin it is not unusual to find that it has started from a segregation of non-metallic particles. He treated a piece of steel in such a way as to produce slight intercrystalline brittleness, and then stressed it above the elastic limit. A number of small cracks appeared, and in nearly every case they started from one or more non-metallic inclusions.

He next heat-treated a heavy slab known to contain inclusions, and carried out tensile tests on pieces machined along the length in the direction of rolling, and also at right angles to this direction through the thickness of the slab. The length-test was in the same plane as the centre portion of the thickness-test, so that they were in every way comparable. The results obtained were as follows:—

	Elastic limit Tons per sq. in.	Ultimate stress Tons per sq. in.	Percentage elongation on 2 in.	Percentage contraction
Length (A) ...	24	43·2	27·0	65·8
Thickness (B) ...	18	34·5	4·0	16·8

These remarkable differences in properties, particularly as regards the ductibility of the steel, are due solely to the presence of the non-metallic inclusions, which in the fractured tensile surfaces of (B) appear as thin circular discs. McCance goes on to point out that these have acted as small areas of zero strength which have lowered the effective area of the test piece, though this is not the only effect they have, and he considers the distribution of stress in such a composite material. It has been proved experimentally by two different methods that the stress at the edge of a circular hole is three times that of the average. In the case of inclusions the elastic properties of which differ from those of the surrounding steel, the differences in stress at the edges will not be so great as for holes, but the edge-stress will still be greater than the average. "In steel, therefore, which possesses even slight brittleness the presence of inclusions may give rise to cracks when such material is stressed, though in steel which has received proper thermal treatment during rolling, forging, etc., inclusions, so long as they are evenly distributed and small, will have an effect which is quite negligible. It is only when they begin to form groups that they have a detrimental effect, and this power which they have to segregate is, unfortunately, without control in the existing state of our knowledge, so that the only way to minimise the chance of segregation is to lessen the number of inclusions present."

In his paper McCance considers the method of occurrence and composition of the various non-metallic inclusions and how they are formed. According to him, there is no evidence that any of them are soluble in molten steel. In other words, they exist as suspensions, and therefore do not obey the laws governing the segregation of elements soluble in liquid steel. Being lighter, they tend to rise to the surface. Assuming, as he does, that the particles exist as spherical globules (density=4), and that the viscosity of liquid steel is about the same as that of mercury, he calculates their velocity of rising (undisturbed) as follows:—

Diameter of particles	Velocity of rising
$10{\cdot}0 \times 10^{-3}$ cm.	80 cm. per minute.
1·0 ,,	0·8 ,,
0·1 ,,	0·008 ,,

Taking for purposes of illustration an ingot of 140-cm. length, which set in twenty minutes from the time the mould was filled, and ignoring convection currents, he calculates the percentage of the number of particles of each size which would be entrapped in the solid metal thus:—

Diameter of particles	Per cent. entrapped
All over $3{\cdot}0 \times 10^{-3}$	0
,, ,, 2·0 ,,	54
,, ,, 1·0 ,,	88
,, under 0·5 ,,	100

Convection currents play an important, though uncontrollable, part in determining both the position and size of the inclusions in every steel ingot. Inasmuch as the viscosity of the steel diminishes as the temperature rises, the metal should be cast as high above that of the liquidus as is practicable.

The greater part of the paper contains a detailed study of the identification and mode of occurrence of the inclusions commonly met with, *e.g.* manganese sulphide and its oxidation products, manganese silicates, iron oxide scales and silicates, acid open-hearth slags and their reduction products, fluxed refractory materials, and oxide inclusions. Iron sulphide, which is scarcely ever encountered, and the action of aluminium on the sulphides of iron and manganese are also dealt with. By means of various etching reagents any inclusion can be classified as a sulphide, a silicate, or an oxide, though research is required for the working out of more suitable reagents than at present exist.

In his final section the author discusses the equilibrium conditions in liquid steel. He considers that ferrous oxide plays a most important *rôle* in determining the origin and occurrence of inclusions, and that all the evidence favours the view that this substance is present in the liquid. The addition of manganese in the form of ferro-manganese causes the reaction $Mn + FeO = Fe + MnO$ to take place, and the oxides so formed, if uncombined, further form inclusions. The reduction, however, is never complete. Inclusions of this type contain invariably between 60 and 70 per cent. of MnO and from 21 to 28 per cent. of FeO, and this is an expression of the equilibrium relations between the two oxides. Silicon and aluminium also act strongly on ferrous oxide, and to an enhanced degree as compared with manganese. The ferrous manganous oxide complex passes, if sufficient silica is present, into a silicate, and ultimately into manganese silicate only. In the author's words, therefore, ferrous oxide "is an influence for evil in every class of steel, for when it is not removed it is the cause of blow-hole formation, and when it is removed from solution it leaves as a non-metallic inclusion a record of its previous existence."

It would appear, therefore, that in the manufacture of steel the chief desideratum, if inclusions are to be kept down to a minimum, is to finish with a bath containing the minimum of ferrous oxide. This is achieved in practice by working at as high a temperature as possible, which produces not merely less oxide in the steel, but also less iron in the slag, *i.e.* a more silicious slag, and the theoretical justification for it is clearly shown in the paper. H. C. H. C.

EDUCATION, SCIENCE, AND LEADERSHIP.[1]

SINCE the last annual meeting of the guild all questions of education have been under discussion, and we now know better where our weakness lies and the extent and nature of our needs. In the number of our institutions providing higher education America alone stands ahead of us. Sir Robert Hadfield has pointed out that Great Britain and Ireland have one university per 2½ millions of population as compared with one million in America. In the Dominions, on the other hand, where the population is relatively sparse and the distances great, the proportion is one university to two-thirds of a million of people. This numerical comparison is, however, misleading, except that it indicates educational centres capable of extending their activities. The true criticism is the number of students who undergo a complete course of training. Of full-time students only 4400 entered our universities in 1913–14, and of them several hundred were foreigners who would later leave this country. Putting the output of university and technically trained men and women in another way, it appears that per 10,000 of population there were sixteen full-time students in Scotland, thirteen in Germany, ten in the United States, six in Ireland, five in England, and five in Wales. The figure given for the United States includes only students at universities and technical schools of recognised standing. If all students taking four-year courses at these institutions were included, the rate per 10,000 of population would be doubled. It is impossible not to believe that these figures help to account for the high standard of intelligence in Scotland and America, and for the success of the Scottish and American peoples in many spheres of activity, while the relative backwardness of England, Ireland, and Wales must exercise an influence in public life.

The financial test shows a deplorable inferiority to the United States and Germany, and must indicate roughly the relative importance attached to higher education in these countries and our own. Thus the total income of State-aided modern universities and university colleges in England and Wales is about 700,000*l.*, of which 34 per cent. is derived from Parliamentary grants. The corresponding figures for Germany are nearly 2,000,000*l.* and 80 per cent., and the University of Berlin alone receives from the State an annual grant nearly equal to that given to all our universities and university colleges. The annual income of the American universities and colleges is 20,000,000*l.*, of which 7,000,000*l.* is at the disposal of the colleges of agriculture and mechanical arts. Private benefactions towards higher education in the United States amount to more than 5,000,000*l.* a year. With us they do not reach one-twentieth part of this sum.

The only possible inference from these figures is that, as compared with the United States and Germany, our higher education is lamentably inferior in quantity. We are not producing trained leadership sufficient for our needs, and the diffusion of knowledge is pitifully inadequate to the requirements of a modern State. If an analysis of the kind of training received by our governing classes were possible, it would be found that scientific knowledge was exceedingly rare and even non-existent in some quarters where it is essential. Sir Robert Hadfield states that in one important Government institution devoted to educational work about 90 per cent. of the principal officials have received a classical training, and only 5 per cent. have been educated in science. Mistakes and inertia in the direction of public policy and in administration are thus explained. There is not enough knowledge of the right kind in Governments, departments of State, or Parliaments, while, in the world of industry, a sufficient supply of trained research workers cannot at present be obtained. Until this requirement is fulfilled the development of new industries on a large scale must be impracticable.

The excellent report of Sir Joseph Thomson's Committee on the position of natural science in education throws a flood of light on our national deficiencies, and points the way to educational reconstruction. The Committee justly claims for sound science teaching that "it quickens and cultivates directly the faculty of observation. It teaches the learner to reason from facts which come to his notice. By it the power of rapid and accurate generalisation is strengthened. Without it there is real danger of the mental habit of method and arrangement being never acquired."

All thoughtful students of our public affairs must admit that, alike in peace and in war, our leaders in all classes have shown a certain lack of the qualities which science training can impart, and that national interests have suffered grievously for this reason. The power of reasoning from facts and of "rapid and accurate generalisation," combined with the habit of "method and arrangement," is the best possible qualification for Cabinet Ministers as well as for all leadership on lower planes; and the British Science Guild has persistently urged that science should take a prominent place in the education of our public servants.

The Committee recalls the fact that the neglect of science was noted by a Royal Commission on the public schools more than half a century ago. The position of scientific instruction in the United Kingdom was also surveyed in detail in 1870–75 by a Royal Commission, of which the seventh Duke of Devonshire was president and Sir Norman Lockyer, the founder of this guild, secretary. But although there has been advance in recent years, it has required the shock of a world-war to make us wide awake to our shortcomings. The champions of classical learning are now moderate in their claims. The Council for

[1] From the presidential address delivered at the annual meeting of the British Science Guild, June 19, by the Right Hon. Lord Sydenham, G.C.S.I., F.R.S.

Humanistic Studies declares that the future citizen should possess knowledge, not only of the physical structure of the world, but also of "the deeper interests and problems of politics, thought, and human life," and that he needs "scientific method and a belief in knowledge even more than physical science." This marks a change of attitude, and the advocates of the dominance of science in education would agree with the proviso that applications of science unknown to the ancients determine the conditions of health and of economic stability in modern life, and that a "belief in knowledge" and method in pursuing it are best inculcated by the study of law in the natural world.

The great merit of Sir Joseph Thomson's report is that it discloses the present causes of the weakness of science in our education. The universities as a whole now show a bias in favour of science teaching, but there is a deplorable lack of students, due partly to weakness in the schools, and partly to the influence of scholarship examinations in which classics predominate. Thus the old universities, by their scholarship systems, tend to discourage science teaching in the public schools, and the public schools react upon the preparatory schools. It follows that many of the most intelligent boys are deterred from entering upon a scientific career. It is also possible that some class prejudice, based upon long tradition, dating back to the Renaissance, may still operate against science training. The recommendations of the Committee are wise and far-reaching, but I can give only the barest indication of their objects and scope. Nature-study in primary schools up to the age of twelve is to be the foundation, and instruction in science up to the age of sixteen is enjoined upon all secondary schools, physics and chemistry to be taught, because all other sciences, to which they should be treated as passports, require some knowledge of them. Mathematics should be connected with science at an early period. The general aims of a science course at school age are defined with the view of securing two educational objects of primary importance:—

(1) To train the mind to reason about things the boy observes himself, and to develop powers of weighing and interpreting evidence.

(2) To develop acquaintance with broad scientific principles and their application in the lives of men and women.

No better foundation for the training alike of the statesman, the leader of commerce and industry, and the manual worker can be laid down. The Committee was strongly impressed with the importance of manual work at school-age, and, speaking from personal experience, I am certain that I owe much to the handling of the file and the lathe before I entered the Army, although mechanical pursuits at one time caused me to neglect other studies. I believe that if all classes underwent some manual training there would be a better understanding of the dignity of labour. Rightly distrusting examination tests of the conventional type, the Committee recommends the inspection of all schools.

Higher standards of teaching power, co-ordinated training from the primary school to the university and to the post-graduate stage, with a lowering of fees and a liberal allocation of scholarships to be awarded for "intellectual merit and promise," and not in accordance with the results of set examinations—such are the educational ideals which are set before the country. By these means we may hope in time to develop intelligence now wasted, as the Committee points out, to supply our present deficiency of experts in all branches of science, and to secure more orderly methods of administration and a higher average of leadership.

SCIENTIFIC RESEARCH AND INDUSTRIAL DEVELOPMENT.[1]

AT the request of my friend, Lord Sydenham, I am pleased to support the work which has been so ably carried on by the British Science Guild, now under his leadership. I do so principally for two reasons: First, because of the importance of the work; secondly, because I believe that an erroneous impression exists in many quarters as to the attitude of the producing interests of this country to this work, and I wish to endeavour to remove this impression.

There has been, I fear, a tendency in certain quarters to misjudge the attitude of manufacturers upon this subject. The impression seems to prevail that they are not fully alive to the necessity for research work in connection with their industries. This may be true in some quarters, but, speaking generally, I think there is no body of men more keenly alive to the necessity for a very great development in the application of science to industry.

Among employers there are comparatively few who have studied science or taken degrees in science before entering a business career, but the number of those who have done so has been steadily growing, and is certain to have a great influence upon the future of industry. Further, there is a large number, chiefly of the smaller manufacturers, who have grown up to the practice of "rule of thumb" methods, and will probably never depart from them.

There is, however, a large number, and they are chiefly of the most enterprising and intelligent kind, who have a keen appreciation of what science has done, and may yet do, for their industries, and are alive to the necessity of employing men of scientific attainments, and of encouraging others to undergo a training in science. In my industry I believe there are very few firms which do not employ chemists for the purpose of their business. Mine has never been without them for many years, and has found the value of their services.

I think we cannot absolve Parliament from a share —and that a large one—of the responsibility for our deficiency in scientific research as compared with some other countries. Not only has it been most niggardly in the provision that it has made for the study of science: it has persistently ignored, time after time, the claims of business men for legislation that would enable the application of scientific discoveries to take place, and encourage the application of these discoveries for business purposes. The most familiar illustration of this is the trade in aniline dyes. I maintain that the blame for the unfortunate position of this industry at the beginning of the war rests chiefly upon Parliament. Many times the demand was made by the dye producers that alcohol should be allowed free of duty for dye-making; but requests were refused, and the advantage of free alcohol was enjoyed by the German producers, which rendered economic production here, in competition with them, impossible. Further, year after year we went to the Board of Trade to give us a patent law that would be fair and reasonable, and not protect the foreigner and his inventions without reciprocal treatment in his country, but until Mr. Lloyd George became President in 1906 nothing was done. These, in my opinion, are the two chief causes why the aniline dye trade was virtually lost to this country, and the blame for it rests upon the Government and upon Parliament, and not upon the business man.

The principle that trade must be left severely alone

[1] From an address by Sir Algernon F. Firth, Bart., read at the annual meeting of the British Science Guild held at the Mansion House on June 19.

and nothing be done to stimulate production at home, and that the only thing that counted was to buy in the cheapest market, prevailed here for far too long a period. This war has shattered our self-complacency in the application of this principle. People have learnt a great deal more about business and understand better what is in the national interest, and I hope a different system is going to prevail in the future.

In order to give you evidence of the interest that commercial bodies are taking, and have taken, in this subject, I want to put before you a few facts. During the last six months of 1915 I was chairman of the Sub-Committee appointed by the Board of Trade to take evidence from twelve minor industries which had all been developed in this country in competition with former German supplies. This report was issued to Parliament and published in January, 1916. The first recommendations that we made were:—"That the Committee thought that larger sums should be placed at the disposal of the new Committee of the Privy Council, and also with the Board of Education, for the promotion of scientific and industrial research and training.

"That the universities (the old universities as well as the new universities) should be encouraged to maintain and expand research work devoted to the needs of the main industry or industries located in their respective districts, and that the manufacturers engaged in those industries should be encouraged to co-operate with the universities in such work, either through their existing trade associations or through associations specially formed for the purpose. Such associations should bring to the knowledge of the universities the difficulties and needs of the industries, and give financial and other assistance in addition to that afforded by the city. . . .

"In the case of non-localised industries they should be advised to seek, in respect of the centres of research, the guidance of the Advisory Council of the Committee of the Privy Council for Scientific Research."

In the report we referred to evidence that was put before us to the effect that certain universities are taking up specific forms of research work. For instance, Sheffield University has taken up the subject of glass; at Stoke-on-Trent they are dealing with pottery—hard porcelain, china, and earthenware; and Manchester University is, I believe, equipping itself for studies in connection with the paper trade. I believe that we have got to specialise in the different universities in research work which is interesting to the trade in their localities, and prevent a great deal of the overlapping which now exists.

We followed this up at a meeting of the Associated Chambers of Commerce, when more than five hundred delegates were present from all parts of the country. We considered the development of industry after the war, and passed unanimously this resolution:—

"That His Majesty's Government be urged to inquire into the desirability of fostering and safeguarding those industries in this country which have since the commencement of the war been engaged in the manufacture of articles formerly made, to a large extent, in enemy countries, or any industries which have in the past suffered seriously from German and Austrian competition; and further, for the development of industries generally, His Majesty's Government be urged to provide larger funds for the promotion of scientific research and training."

In June of the same year the Imperial Council of Commerce, representing the Chambers of Commerce of the whole Empire, held meetings in London and passed the following resolution:—"This conference urges that throughout the Empire larger funds shall be provided by the respective Governments in order that the fullest facilities may be given for the promotion of scientific research and training in their relation to our commercial and industrial development."

Before these meetings I went to Sir Alfred Keogh, the head of the Imperial College of Science and Technology in South Kensington, and suggested that, seeing these matters of applied science and scientific research were so prominently in men's minds in chambers of commerce, not only in Great Britain, but also throughout the Empire, he should arrange for the delegates to pay a visit to the Imperial College in order to enable them to realise what is actually being done there. He immediately agreed, and showed us such of the work as was possible in a two hours' visit, when we could have profitably spent two days informing ourselves of the activities of this magnificent college of science. I believe that out of those who went, only three had ever been there before. A fact that Sir Alfred Keogh stated to us made a great impression; it was that before the war there were only a thousand students at this college, and it could quite easily hold two thousand. We ought to be sending on students to a place like this from the whole country, so long as there is an opening for them. We should send them when they have specialised in industrial subjects in order to broaden their minds and increase their knowledge. Sir Alfred stated:—"You will recognise, gentlemen, that the industries of this country are not fully alive to the importance of science, nor are the academies sufficiently aware of the importance of industries in the educational programme." This, we were bound to admit, was an accurate statement of the position.

We are not the only nation that is taking steps in the direction of promoting scientific research. The United States are fully alive to the importance of the matter, and are keeping thoroughly posted on all steps taken here. My experience there—and it is a long one, being a manufacturer in America myself—is that men who are looking to be heads of businesses in the future spend far longer at universities and technical colleges before going to their business than we have been in the habit of doing in this country. We have undoubtedly been remiss in this respect, but I think that general sentiment is changing.

We must realise that scientific research is one of the most important questions that are coming before us in the industrial reorganisation that will follow this war. We must all be impressed by this great factor: that business conditions are not going to be the same in this country or in the world when this great war is over. The war will have to be paid for, and to do so the production of everything, agricultural as well as industrial, has got to be stimulated through all agencies and by improved methods generally. Labour will have to alter and relax all foolish and uneconomic restrictions on output, and I believe in most cases is prepared to do so; but at the same time employers will have to scrap antiquated methods. They have got to root out many old prejudices, and must realise both the possibilities and responsibilities of their position. Our methods have been wasteful in the past; there will be no room for waste in the future. Everything must be turned to account and made the best use of. The old idea that business consists only of buying and selling to the best advantage, or in producing by known methods only, is exploded. A knowledge of world-markets and of opportunities must be more widely diffused and appreciated. Industrial organisation will probably exist in larger units, affording greater opportunities for ability and the application of scientific knowledge. The attainment of the maximum production in industry should be the great object of us all. To secure this, scientific handling of materials and processes is necessary. Constant research, both on general and on particular or individual lines, is essential. This is becoming recognised by producers throughout the whole country.

For these reasons I consider that the British Science Guild has a great field for its activities, and if it continues to press for the attainment of these objects I am sure that it deserves the cordial and hearty support of all who are interested in the safety and expansion of all those industries upon which the future of this nation so largely depends.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. C. R. A. Thacker, late scholar of Downing College, has been elected to a fellowship at Sidney Sussex College. Mr. Thacker was placed in the first class of the Natural Sciences Tripos, part i., in 1911, and part ii. (physiology) in 1912. He is attached to the Special Medical Board of the Ministry of Pensions.

LEEDS.—Capt. M. J. Stewart has been elected professor of pathology and bacteriology in the University. He received his commission in the R.A.M.C. (Territorial Force) in May, 1915, and has served as pathologist to the East Leeds War Hospital, and in a similar capacity in France. A few months ago he was recalled to Leeds, and, at the request of the University Council, undertook the acting headship of the department of pathology and bacteriology. In addition to his hospital and teaching work Capt. Stewart has devoted much time to original research on pathological questions, and has a long list of publications to his credit.

LONDON.—The Senate announces a bequest of 2000*l.* for the engineering faculty of King's College under the will of Lieut. R. C. Hodson, a former student in the engineering department of the college, who was killed in France last year; also a donation of 51*l.* from Miss Gertrude Jones for the purposes of the Galton Laboratory at University College.

Grants have been made by the Senate out of the Dixon Fund for the year 1918–19 as follows:—100*l.*, Mr. Birbal Sahni, to enable him to continue last year's research on Indian fossil plants at Cambridge; 60*l.*, Mr. James Morrison, to enable him to continue research on the igneous rocks of the Lake District; 15*l.*, Dr. H. B. Cronshaw, for expenses in connection with research on the Connemara serpentine rocks.

A resolution was adopted by the Senate on June 19 expressing gratification that the King's College Hospital had decided to open its medical school to women students—"a step which is in entire conformity both with the wishes and the policy of the University."

The following doctorate has been conferred:—*D.Sc. in Geology*, Mr. A. E. Trueman, an external student, for a thesis entitled "The Evolution of the Liparoceratidæ," and other papers.

OXFORD.—The lately published report of the Delegates of the University Museum directs attention to the very large number of members of the teaching staff, research workers, and service staff of the museum and departments who are now serving in the Navy or Army, or are otherwise engaged in work directly connected with the war. A large part of the museum is still occupied by the school of military aeronautics. A new dissecting-room for women medical students has been provided by the liberality of the Clothworkers' Company, a deficit over the sum allotted being generously met by Sir William Osler. Among the special investigations carried on in the several departments have been work on the agglutination curve in relation to typhoid and paratyphoid fevers, tetanus, "mustard gas," the commercial production of toluene from petroleum, the sulphonation of benzene and the manufacture of synthetic phenol, and the preparation of new chloroamides for use as antiseptics. A considerable amount of research work has also been published on subjects not directly connected with the war. The curator of the Pitt-Rivers Museum reports a very large accession of specimens by donation, chief among which are the examples presented by Lady Tylor from the collection of her late husband. Other important accessions have been received from Mr. J. H. Hutton, Mrs. Braithwaite Batty, Mr. A. S. Kenyon, and Major R. G. Gayer Anderson.

THE HON. SIR C. A. PARSONS has consented to fill the office of president of the Polytechnic School of Engineering, Regent Street, in succession to the late Mr. C. Hawksley.

WE learn from a message from the Rome correspondent of the *Times* that the British Institute at Florence was formally opened on June 21 by Sir Rennell Rodd, Ambassador to the Court of Italy, who said that as Florence was the intellectual centre of Italy, the British Institute in Florence would provide facilities for the study of English by practical and scientific methods, the courses including classes in English history, geography, and literature. An attempt would also be made to explain and illustrate the chief problems of the British Empire. It was hoped that in the future the institute might become a point of contact between the principal British and Italian universities.

AT a series of conferences held during the present year representatives of the non-professorial teaching staffs of the universities and university colleges of England, Ireland, and Wales decided to take joint action for the purpose of securing an improvement in status, tenure, and salary. A memorandum has been prepared setting forth the present conditions of service and remuneration, which are admitted to be unsatisfactory by all conversant with the facts, and suggesting various remedies. Of these the most important is that the lecturing staff should be divided into three grades. The lowest grade would comprise appointments of a probationary character to last not more than three years. At the end of that time the junior lecturer or demonstrator should cease to hold the appointment, or, if it is desired to retain his services, he should be promoted to the next grade, that of lecturer on the permanent staff. The highest grade would be composed of senior lecturers and lecturers in charge of departments. It is suggested as essential that there should be a definite minimum commencing salary in each grade, with substantial annual increments, and that lecturers should have a greater security of tenure, more time for study and research, and more adequate representation on bodies that control the teaching in each university or college than prevail under existing arrangements. The memorandum is being presented to the governing bodies of each university or university college concerned, and there is reason to believe that the recommendations contained in it will receive favourable consideration. No improvement of salaries, however, can be expected without substantial aid from increased Treasury grants, and the promoters of the movement intend to make representations to the Government that such increases of grant should be given as would make it possible for governing bodies to meet the not unreasonable claims which have been put forward.

SOCIETIES AND ACADEMIES.

London.

Royal Society, June 13.—Sir J. J. Thomson, president, in the chair.—Admiral Sir Henry **Jackson**: Experiments on the effect of the vibration of a stretched wire forming part of a closed electric circuit. A large thermo-microphone consisting of a long loop of wire warmed by an electric current, subjected to vibration produced by sound-waves, continued to respond to and record the effect of the vibration in suitable receiving apparatus after the electric battery had been cut out of its circuit, and when the wire was at the same temperature as the air. This result of the wire's vibration could not, therefore, be solely attributed to the wire being maintained at a different temperature from that of the surrounding air by an electric current in it. The response to the sound and other vibrations was generally recorded by means of an amplifier and telephones. Experiments were carried out to elucidate the cause of the phenomenon. It is shown that resonance plays an important part. No definite conclusions, however, can yet be drawn as to the quantitative effect of altering tension or length of wires, or their displacement, on current generated, nor does the energy expended in producing vibration appear to be proportional to the effect produced, unless resonance is present.—A. **Mallock**: Note on the effect of wind-pressure on the pitch of organ-pipes. The fact that the pitch of an organ-pipe is to some extent dependent on the pressure of the wind supply is well known, but no satisfactory explanation of this dependence has hitherto been offered. In the present note some experiments on the subject are described in which water instead of air was used as the oscillating fluid. It is shown by photography that the lateral motion of the fluid jet or lamina which maintains the oscillation is always in the direction of the oscillating flow, and also that the oscillation is not (or only very feebly) maintained unless the jet breaks up into eddies before striking the "lip" of the pipe. It is suggested that the rise of pitch which occurs when the jet velocity is increased depends on the jet acting as an injector. Part of the fluid belonging to the oscillating flow becomes involved in the eddies of the jet, and is accelerated by energy drawn from this source, thus diminishing the amount of energy which would otherwise have to be taken from the oscillating system. In effect, this action reduces the oscillating mass, and thereby increases the frequency. The results obtained with the water oscillator are compared with Lord Rayleigh's experiments on organ-pipes, and it appears that the variation of frequency with the pressure of the fluid supply is similar in type in both cases.—Dr. A. E. **Oxley**: The diamagnetism of hydrogen and the value of the magneton.

Optical Society, June 13.—Prof. F. J. Cheshire, president, in the chair.—H. **Lee**: A chart for finding the number of lenses in, and size of, a block. The chart shows by two series of intersecting curves the number of lenses it is possible to place in any ring of a block (up to ten rings) when the maximum diameter of the block, the diameter of the lens, and the radius of curvature to which the lenses to be worked are given. Any case likely to arise in the workshop can be at once determined by interpolation between the curves shown. The diagrams exhibited are for the two cases when the first ring contains one lens and three lenses respectively. The formulæ from which the charts were calculated are given.—H. S. **Ryland**: The prevention of filming in enclosed optical instruments. (1) The filming is independent of the nature of the glass; (2) the film itself is always alkaline; (3) it is progressive; (4) it is avoided by absolute cleanliness during the assembling of the instrument, by taking care that no soap or animal matter is left upon the glass surfaces, and that no volatile as water-bearing material is used inside an enclosed instrument.—T. **Smith**: Charts for assisting in the selection of suitable glasses for cemented doublets. Use is made of two charts sliding one over another in the manner in which a slide-rule is used, one of the charts being transparent. A single variable suffices to determine very approximately the numerical relation between the various spherical aberrations for all cemented doublets made from two given glasses. Chart No. 1 contains curves corresponding with constant values of this variable, the independent variables being the difference in the refractive indices of the two glasses and the logarithmic difference of their powers. The second chart consists of points defining the available types of glass, the scale in one direction varying with the type of chromatic correction desired. The glasses are selected by superposing one chart on the other and finding two representative points on No. 2 which satisfy the condition that one point lies on the curve of No. 1 corresponding with the required type of spherical correction when the other point is on the origin of chart No. 1.

Paris.

Academy of Sciences, June 3.—M. P. Painlevé in the chair.—G. **Humbert**: The number of classes of indefinite forms of Hermite.—G. **Bigourdan**: The observatory of the Louis-le-Grand College (last period) and the astronomical work of the French expedition to Pekin. Historical account of work done during the period 1753 to 1782.—M. **Hamy**: The diffraction of the solar images.—Y. **Delage**: Lymphatic bleeding as a means of deintoxication. In cases where there is a limited amount of a toxin in the system, and where bleeding followed by transfusion is too dangerous, the possibility of a lymphatic bleeding is suggested, with a subsequent introduction of a sufficient quantity of artificial blood serum. The operation would admittedly be difficult, on account of the smallness of the lymphatic vessels and the nature of their walls.——Ch. **Depéret**: An attempt at the general chronological co-ordination of Quaternary times.—G. A. **Boulenger**: The Helodermatid lizards of the Upper Eocene in France.—G. **Giraud**: A partial differential equation, not linear, of the second order, connected with the theory of hyperfuchsian functions.—A. **Buhl**: The volumes swept out by the rotation of a spherical contour.—E. **Belot**: The great velocities in novæ and the vortex theory of cosmogony.—A. **Véronnet**: The contraction of stars and equilibrium of nebulæ.—E. **Léger**: α-Oxycinchonine. The compound previously described as oxycinchonine is shown to be α-oxydihydrocinchonine, and is formed by the addition of a molecule of water to cinchonine.—J. **Peyriguey**: A waterspout in the Gharb.—D. **Berthelot** and R. **Trannoy**: The evolution of the saccharine principles of the sorghum and the influence of castration. In normal times sorghum cannot compete with beetroot or sugar-cane as a source of sugar. Owing to the presence of levulose, glucose, and gums, the sorghum juices crystallise badly. Moreover, after the plant is cut the saccharose reverts, and this phenomenon is even shown by the growing plant after a certain date. As the plant is easily grown, the juices expressed in a domestic fruit-press may be used in syrup form with advantage under present conditions.—L. **Lindet**: The influence that the vegetable function of yeast exerts on the yield of alcohol: a new interpretation of the fermenting power.—J. **Nageotte**: The value of the ultramicroscope in histological investigation. The ultramicroscope can render great services to histology, but reasons are given to show that negative results must not be taken as proving absence of structure.—J. **Amar**: The psychograph and its applications. Description and photograph of an apparatus for graphically recording reaction times.—F. **Maignon**: Researches on the toxicity of egg-albumin. The influence of the season on the sensibility of the organism to nitrogenous intoxication. A diet of white of egg alone is incapable of supporting life or maintaining weight in the white rat. The rats on this diet die rapidly in May and October of an acute intoxication of the central nervous system, whilst they die slowly by starvation in August and January.—M. **Lécaillon**: The action of the venomous bites of *Ammophila hirsuta* on the caterpillars of *Agrotis ripae*.

June 10.—M. P. Painlevé in the chair.—G. **Humbert**: The representation of an integer by indefinite, ternary quadratic forms.—J. **Boussinesq**: The graphical integration of the problem of sandy flow in the case of a *terre-plein* with free undulating surface maintained in front by a curved wall.—E. **Ariès**: Saturated vapour-pressures of pentatomic bodies. The only conclusion which can be drawn from the existing experimental data is that stannic chloride, methyl fluoride, and chloroform in a state of purity ought to have saturated vapour-pressures which satisfy the law of corresponding states.—J. **Pérès**: Certain functional transformations.—M. de **Pulligny**: The approximate quadrature of the circle.—H. **Bourget**: The intrinsic brightness of the starry sky.—Sir F. W. **Dyson**, MM. **Luizet**, **Moye**, and C. **Sola**: Telegrams announcing the appearance of Nova Aquilæ.—M. **Brillouin**: Biaxial media.—P. L. **Mercanton**: The magnetic state of some prehistoric pottery. The examination of five further examples confirms the results given in an earlier note that the terrestrial magnetic inclination in the bronze in Switzerland was nearly zero.—M. **François**: A new method for the determination of mercury with zinc.—J. **Martinet**: The isatic acids. Details are given of the preparation of 5-methylisatic acid, 5:7-dimethylisatic acid, and α-naphthisatic acid. These acids dissolve immediately to a yellow solution in alkalis without passing through the intermediate violet colour of the corresponding isatins.—J. **Bougault**: The amide function. The author's work on the acidylsemicarbazides and the acidylhydroxamides leads him to the conclusion that the acid amides are normally of the constitution $R,C(OH),NH$ instead of the usually accepted $R.CO.NH_2$.—A. **Guilliermond**: Metachromatin and the phenolic compounds of the plant-cell.—C. **Janet**: *Botrydium granulatum*.—H. **Bierry** and P. **Portier**: Vitamines and symbiotes. The bacteria isolated from the tissues of normal animals (symbiotes), like the vitamines, are abundant in the teguments of seeds and in many animal fats, and their temperature of destruction, about 120° C., is also near the temperature of the alteration of vitamines, and it is suggested that there is a relation between the symbiotes and the vitamines. Preliminary experiments showed that symbiotes are perfectly tolerated when introduced into vertebrates. Animals (rats, pigeons) fed on a diet deprived of vitamines were reduced to the pathological state described by various workers. The injection of cultures of living symbiotes under the skin or in the peritoneum produced a rapid recovery in twenty-four to forty-eight hours. These results were repeated and confirmed by experiments lasting several months.—Y. **Delage**: Remarks on the preceding paper. Attention is directed to the fact that the animals in the pathological state described still contain symbiotes in their tissues, and it is difficult to see how the introduction of more of the same bacteria could be responsible for the effects observed.—Mlle. Marie **Goldsmith**: Sensorial perceptions in *Eupagurus Bernhardus*.

BOOKS RECEIVED.

Forestry Work. By W. H. Whellens. Pp. 236. (London: T. Fisher Unwin, Ltd.) 8*s*. 6*d*. net.

Chemistry for Beginners and School Use. By C. T. Kingzett. Third edition. Pp. 151–211. (London: Baillière, Tindall, and Cox.) 2*s*. 6*d*. net.

A Primer of Engineering Science. By E. S. Andrews. Part ii. First Steps in Heat and Heat Engines. Pp. ix+67. (London: J. Selwyn and Co.)

DIARY OF SOCIETIES.

THURSDAY, JUNE 27.

ROYAL SOCIETY, at 4.30.—Periodic Irrotational Waves of Finite Height: Prof. T. H. Havelock.—The Diffraction of Electric Waves by the Earth: Dr. G. N. Watson.—Sounds Produced by Drops Falling on Water: A Mallock.—Concerning Emotive Phenomena. II.: Periodic Variations of Conductance of the Palm of the Human Hand: Dr. A. D. Waller.—The Mechanism and Control of Fibrillation in the Mammalian Heart: Prof. J. A. MacWilliam.—The Development of the Sea Anemones, *Actinoloba dianthus* and *Adamsia palliata*: Dr. J. F. Gemmill.—The Occurrence of Multinucleate Cells in Vegetative Tissues: R. Beer and Agnes Arber.—The Epithelial Sheath of Hertwig in the Teeth of Man, with Notes on the Follicle and Nasmyth's Membrane: Dr. J. H. Mummery.—*And other Papers.*

FRIDAY, JUNE 28.

PHYSICAL SOCIETY, at 5.—A New Method of Measuring Alternating Currents and Electric Oscillators: I. Williams.—Demonstration of Coupled Vibrations: Prof. E. H. Barton and Miss H. M. Browning.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, JULY 4, 1918.

PHOTOGRAPHY: PRACTICAL AND THEORETICAL.

The Science and Practice of Photography: An Elementary Text-book on the Scientific Theory and a Laboratory Manual. By Dr. J. R. Roebuck. Pp. xiv+298. (New York and London: D. Appleton and Co., 1918.) Price 2 dollars net.

THIS is really two books, each with its own preface, though the paging is continuous. The second part consists of the laboratory instructions that the author issues to his students as they work through the prescribed course. These instructions are not modified to render them suitable for others than those for whom they were originally intended, and so we are told that "the staff reserves the right to impose fines" for breakages, that the work "confers two credits," and so on. This is a trivial matter, but when we are repeatedly told to consult the bulletin board, or to apply to the instructor, the difficulty is real; and, seeing that the bulletin board and the instructor are in Wisconsin, and we are in London, these sources of information are impossible for us. The course prescribed is an excellent series of twenty-four experiments in the making of negatives, printing by various processes, spectrum photography, photomicrography, enlarging, the use of autochrome plates, and, finally, getting the characteristic curve of a plate by means of the Chapman Jones plate tester.

The first part of the volume is of the nature of an ordinary text-book, though after a few pages of historical matter the author begins, perhaps advisedly in dealing with students who have already studied chemistry and physics, with the properties of gelatine dry plates as demonstrated by the work of Hurter and Driffield and some of those who have followed them. Then come chapters on colour sensitiveness, latent image theories, negative defects, positive processes, lenses, the photography of colour, and a chapter on "good pictures" that deals with pictorial matters. There is a constant feeling in reading some of these chapters that matters are mentioned rather than dealt with—perhaps intentionally so, seeing the circumstances in which the book was originally intended to be used. Still, we think that, having taken the trouble to give a diagram to illustrate the production of halation and two pages of text to the consideration of it, the author might have explained the production of the definite ring of light round a small illuminated area, which, indeed, is excellently shown in some actual examples given. We are told in the preface that the substance of the book has been in use for seven years, and has received innumerable additions and corrections. But there still remain some statements that need correction or qualification. Taking the first few pages: "Toward the end of the eighteenth century chlorine, bromine, and iodine had all been discovered and studied" should have "bromine and iodine" deleted, as these were not known until 1826 and 1812 respectively. In the next line, the statement that Davy and Wedgwood "coated plates," and with, among other salts of silver, "silver bromide and silver iodide," is obviously incorrect, as the results of these experiments were published in 1802. On the next page we read that Daguerreotypes were fixed "by boiling in strong sodium chloride solution" until "when the solvent action of sodium hyposulphite solution on the salts of silver was pointed out to him, he changed over to it"; and a few pages further on, that French chalk is "finely divided calcium carbonate": these are examples of the statements that call for more attention. We think it a pity, too, that the author should have adopted for his book the exact title of a text-book that has been before the public, both in this country and in America, in its various editions, for the last thirty years.

Still, in spite of its drawbacks, there is a refreshing originality about the volume. We appreciate to the full the author's advocacy of the importance of the study of photography from both the practical and scientific points of view. But when he says that "there is no reason why the methods of modern science, as well as its attitude, cannot be taught by a course in photography, as well as by a course in quantitative chemistry, or in the theory of electricity," he doubtless means what is true, but will probably be misunderstood. We want the chemistry, and the electricity, as well as the photography, and all the other branches of science, for though there is a measure of overlap at every division, there is no interchangeability between the various parts of the whole.

C. J.

TEXT-BOOKS OF CHEMISTRY.

(1) *A Text-book of Inorganic Chemistry.* By Prof. A. F. Holleman. Issued in English in co-operation with H. C. Cooper. Fifth English edition, completely revised. Pp. viii+507. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10s. 6d. net.

(2) *Principles of Quantitative Analysis: An Introductory Course.* By Dr. W. C. Blasdale. Second edition, revised and enlarged. Pp. xii+402. (London: Constable and Co., Ltd., 1917.) Price 10s. 6d. net.

(3) *The Chemistry of Linseed Oil.* By Dr. J. Newton Friend. Pp. vii+96. ("Chemical Monographs.") (London: Gurney and Jackson, 1917.) Price 2s. 6d. net.

(1) THE English edition of Prof. Hollemann's "Inorganic Chemistry" has become so widely adopted as a text-book, especially in the States, that any lengthy notice of the fifth edition seems almost superfluous. There are, however, one or two criticisms to which attention may be usefully directed. It seems undesirable in a text-book which is obviously intended for more advanced students to devote valuable space to elementary details at the expense of more im-

portant information. Whilst such elementary matters as the difference between chemical and physical changes, and the operations of filtration, distillation, etc., are minutely described and may well be omitted, we have failed to find any reference to Dalton's law of partial pressures, and such processes as the liquefaction of air, the production of nitric acid from ammonia, and of hydrogen from water-gas, which are at the present time of some importance, are either not mentioned or are very inadequately described—in short, the limited reference to industrial operations gives the book, rightly or wrongly, a pronounced academic bias.

The arrangement is not, perhaps, in all respects the best that could be devised. The electrochemical series, and, indeed, the whole process and theory of electrolysis, are so fundamental in explaining chemical reactions that one naturally expects some reference to them in the earlier portions of a text-book of this character.

Turning to the index, we find a reference is given to p. 428, where even the term "electrochemical series" does not occur; but on p. 436—that is, near the end of the book—the subject is described as of "great practical value," but is discussed only in its relation to electrolytic reactions.

On the other hand, some of the sections on physical chemistry are written in a terse and lucid fashion; these are wholly excellent and constitute the most valuable part of the book.

(2) This is an ideal little book on analysis. Its object, as the title indicates, is not so much the practice as the principles of analysis. Whilst the descriptions of detailed analyses are comparatively few and are selected as typical illustrations of a variety of methods, the general theory of these methods is carefully kept in view.

The first seventy-four pages are exclusively devoted to theory on such subjects as the nature of solution, on equilibrium, and on electrolysis. The practical part is divided into sections, each section illustrating a particular kind of analysis. Thus, the first has reference to processes involving the evolution of gas; the second, to precipitation methods; the third, to methods of extraction, and so forth. Several sections are given to volumetric analysis, and the last to physico-chemical methods.

The book is adequately illustrated with a few simple outline drawings of apparatus, and questions and problems are intercalated at intervals.

(3) This little volume on linseed oil, which forms one of a series of chemical monographs, contains in a small compass a compilation of the better-known chemical facts regarding linseed oil and an account of its evaluation for technical purposes, but has no reference to its industrial applications. It is provided with a very full bibliography of references which should prove useful to the chemist. As the author states in the preface, it is a subject which has not received the attention it merits, and opens a wide field, shared by many other vegetable oils, for more extended chemical investigation.

J. B. C.

THE FUNCTION OF THE SPLEEN.

The Spleen and Anaemia: Experimental and Clinical Studies. By Prof. R. M. Pearce, with the assistance of Dr. E. B. Krumbhaar and Prof. C. H. Frazier. Pp. x+419. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 21*s.* net.

In this pleasant volume on the results of removing the spleen Prof. Pearce has put together the various experimental studies carried out with a number of collaborators in the department of research medicine of the University of Pennsylvania during the past five or six years. Most of the data have been already published in periodicals, but it is convenient to have them in a revised and connected form and to read the author's general discussion of his results taken as a whole. Removal of the spleen in dogs leads to (1) an anæmia of moderate severity, lasting in all from two to six months; (2) an increased resistance of the red-blood corpuscles to destruction by hypotonic salt solution, saponin, and other hæmolytic agents; (3) a diminished susceptibility to hæmoglobinuria and jaundice induced by the injection of hæmolytic serum. The mere absence of spleen is never fatal, never, indeed, induces anything that could be called severe illness, and in six or twelve months the animals are normal again, except, perhaps, in respect of the resistance of their red corpuscles to laking. A number of paths have been pursued in search of some general explanation of these phenomena, and it must have been disappointing to find them mostly fruitless.

A good deal of the general discussion is necessarily barren because the authors have never inquired whether the anæmia is due to a deficiency of hæmoglobin or to a relative increase in the plasma, a point which is quite fundamental in considering the nature and effects of any anæmic process.

Most noteworthy are the observations that ligature of the splenic vein or its implantation into the inferior vena cava leads in some respects to much the same results as complete excision of the spleen, and that ultimately there is considerable hypertrophy of the bone marrow, not apparently to form blood-cells, but to act, as does the normal spleen, as a reservoir of iron. A long section, in which the well-known work of Dr. Sam Goldschmidt is incorporated, on metabolism in dogs and men before and after splenectomy leads to no definite aberration being found.

About a fifth of the whole book is occupied with a straightforward account of the "splenic anæmias" by Dr. E. B. Krumbhaar, in which the modern methods of clinical examination are given in detail. Evidence seems fairly conclusive that Banti's disease, Gaucher's disease, and acholuric jaundice are best treated by removing the spleen, and there must by now be a good number of people in the world who might be used to test the belief of antiquity that one could run faster if one had no spleen. Finally, there is a short chapter on surgical technique by Prof. C. H. Frazier, a full bibliography, and a splendid index.

One point remains for criticism. The work presented is a typical example of that association of animal experimentation with practical medicine and surgery which has made such definite headway in recent years, especially in America. It is perhaps beside the point that in this particular case the contribution made by the experimentalist is rather meagre of practical indications. There can, however, be little doubt that the practice of restricting experimentation to one species of animal, generally, as in the present instance, the dog, is a dangerous technique if it is proposed to apply the results in detail to man. The truth of the matter seems to be that while the end which different animals will attain is the same (*i.e.* they will so far as may be restore themselves to the normal state or somehow or other get round their difficulties), the means and detailed mechanism of restoration and compensation will likely vary widely in various species; they are, of course, relatively immaterial to the individual concerned.

A. E. B.

OUR BOOKSHELF.

Proceedings of the Aristotelian Society. New Series. Vol. xvii. Pp. 497. (London: Williams and Norgate, 1917.) Price 12*s.* 6*d.* net.

NOTWITHSTANDING the war, the Proceedings of the Aristotelian Society suffer no diminution in bulk. During the thirty-eighth session thirteen papers have been given, and two symposia have taken place. One of the latter, on the ethical principles of social reconstruction, deals directly with the war and some of its issues. In the other symposium the question is discussed whether the materials of sense—or "presented sensations," as G. E. Moore prefers to phrase it—are affections of the mind.

The Dean of St. Paul's writes suggestively of some phases of the philosophy of Plotinus. M. Ginsberg gives a critical account of Malebranche's theory of knowledge. C. Lloyd Morgan, discussing fact and truth, and distinguishing facts of appearance from facts of knowledge, points out that the former are facts *for* knowledge. The static nature of truth-structure and of fact is repudiated. C. E. M. Joad deals with the onslaughts of the pragmatists and the new idealists on the theory of monism. Relations are real, external, and experienced. The fundamental objections to monism are logical. Bernard Bosanquet discusses the function of the State in furthering the unity of mankind, but it may be questioned whether a "communal" mind actually exists. A. N. Whitehead emphasises the idea that logic is the organising principle by which observation is elaborated into science. C. D. Broad criticises Hume's handling of miracle, and concludes that miracles might, but do not, happen. W. A. Pickard-Cambridge writes of the relation of value to our consciousness. The various subjective criteria offered us are inadequate or erroneous. We have innate, direct, unique knowledge of value. G. Dawes Hicks attacks the problem of realism. Matter and mind are disparate entities. The *esse* of sensible objects is not merely *percipi*. There is no distinction between the mind and its states. The mind *is* its states. J. S. Mackenzie emphasises the dynamic value of the view that the universe is an intelligible whole. Miss L. S. Stebbing also contends that the conception of concrete unity is valid and stimulating.

H. Wildon Carr's presidential address inquires into the nature of recognition as a modified cognition, and also discusses racial or instinctive recognition. The volume is suggestive and stimulating, and we regret that space does not allow of more extended notice.

W. L. S.

Aids to Rational Therapeutics with U.S.A. Pharmacopoeia Equivalents. By Dr. R. W. Leftwich. Pp. x+233. (London: Baillière, Tindall, and Cox, 1918.) Price 3*s.* 6*d.* net.

IN many books on the treatment of disease the plan adopted is to discuss each disease and to indicate its treatment. This leads to much needless repetition, for in many instances the same general treatment may be applied to many different diseases. If, for example, we take the case of the infectious fevers, almost the same line of treatment may be adopted for all, with here and there a slight modification or addition. The author of this book has acted upon this principle: he divides diseases into some forty groups, discussing the general treatment applicable to each group, and then adding any special method indicated for any particular case. Thus, selecting at random, we have such groups as the catarrhal, the anæmic, the abscess, the malarial, the rheumatic, the cardiac, the vitamine insufficience, etc. The grouping seems to have been particularly well done, and the information given in almost all cases is accurate and sufficient. Thus that rare disease, rat-bite fever, and its treatment with salvarsan are mentioned. Throughout, typical prescriptions are given, and, in addition, dietetic, electrical, and other forms of treatment are described as required. By adopting this plan the author has succeeded in compiling in a comparatively small space a complete system of treatment, and we believe that the book will be of considerable service to the young practitioner. In an appendix some useful hints are given on dealing with patients in private practice.

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.*]

The Profits of Research.

A NOTIFICATION issued by the Department of Scientific and Industrial Research, entitled "Notes on the Conditions under which Grants are made to Students-in-Training and to Individual Workers," states that the Department, with the object of encouraging research into fundamental problems of pure science, is prepared to make grants to workers in educational institutions and elsewhere. I think the condition imposed in paragraph (14), which I quote, deserves a wider publicity.

"(14) It should be noted that grants to research workers will be subject to the following conditions [among others]:—

"The results of the investigation as obtained from time to time shall, in the first place, be communicated to the Committee of Council, who, after consultation with the bodies and persons who have co-operated in the conduct and maintenance of the research, shall determine in the national interest whether, and if so to what extent and under what conditions, the results shall be made available.

"The Committee of Council reserve the right to determine, after consultation with the bodies and persons who have co-operated in the conduct and maintenance of the research, whether, and if so to what extent and in what proportions, the Committee of Council and those bodies and persons shall secure to themselves by patent, designs or otherwise, the ownership of the results of the research and any benefits and profits arising therefrom.

"It is not expected that results of direct technical value will often be obtained from research undertaken by a student in training, and the conditions stated above are not, therefore, attached to a grant to a student. But the professor and student will be asked, should results apparently of commercial value be produced, to consult the Department before taking any action to make the results public, or to communicate them to an industrial firm or other body for exploitation."

I sincerely trust that scientific investigators, whether professors or students, will read, mark, and inwardly digest paragraph (14), and think twice before they accept any grant from the Department of Scientific and Industrial Research. They have the right to know who is responsible for the imposition of this condition.

FREDERICK SODDY.

THE SUGAR INDUSTRY AFTER THE WAR.

UNDER the above title, Mr. T. H. P. Heriot, the lecturer on sugar manufacture at the Royal Technical College, Glasgow, has communicated a paper to the Royal Philosophical Society of Glasgow which has recently been published in its Proceedings. Since its appearance the subject has occupied the attention of the Royal Society of Arts, and the issue of the journal of the society for June 14 contains an interesting paper by Mr. George Martineau, which traverses much the same ground as that of Mr. Heriot and arrives independently at the same conclusions. The subject is so important at the present juncture, and our position with respect to it, in view of our prospective relations with our enemies, so serious, that no excuse is needed for referring to it. The general course of the development of the sugar industry is too well known to require any detailed description. Both authors deal with it in the introduction to their papers at just sufficient length to render the nature of their arguments and the conclusions to which they arrive intelligible and obvious to their readers.

Originally, all the sugar consumed in this country, and in Europe generally, was made from the sugar-cane, and most of it was imported from the West Indies. It was known, however, so far back as the middle of the eighteenth century, that the particular kind of sugar—sucrose—with which we are now concerned existed in other plants than the sugar-cane. In 1747 the chemist Marggraf pointed out that it was present in the beetroot, then being cultivated on an extensive scale in Silesia as a forage crop, and his pupil, Achard, a Frenchman who had settled in Germany, grew the root on his estate, and set up a small manufactory for extracting sugar from it. The success of this enterprise induced King Frederick William of Prussia, in 1801, to supply funds for the creation of beetroot-sugar factories. The industry may be said, therefore, to take its rise from the beginning of the nineteenth century.

The Continental disturbances of that time, combined with our maritime supremacy and the effectiveness of our blockade, especially of the French ports, gave a great impetus to the development of beetroot-sugar manufacture. Napoleon, with characteristic sagacity, quickly saw in the beetroot a method of countering our blockade, at least so far as regarded the import of sugar. By his orders tens of thousands of acres of French soil were planted with beetroot, and schools of instruction in the art of cultivating it and in the methods of sugar-making were founded by his direction. Before Waterloo ended his career the beetroot-sugar industry of the Continent had been firmly established both in France and in Germany, and to that extent the future welfare of our West Indian possessions was, as Napoleon clearly foresaw, seriously jeopardised.

The creation of the beetroot-sugar industry was due entirely, in the first instance, to the exertions of men of science who had no practical acquaintance with the art of sugar manufacture. Its development has been largely owing to their labours. They have studied the mode of growth of the root and the conditions under which the sugar is secreted, and they have thereby succeeded in greatly increasing the sugar content. By careful and intelligent investigation they have enormously improved the methods of sugar extraction and subsequent treatment. They have brought chemical knowledge and skill to bear on the improvement of the analysis of saccharine materials and on the elucidation of many problems of a chemical nature connected with the industry. There is probably no branch of technology that could be named in which science has been more successfully applied than in the creation and development of the beetroot-sugar industry. On the other hand, science, in times past, had little to do with the sugar-cane industry, and so long as the West Indian planters could count upon the enormous profits that they formerly enjoyed, they had little or no inducement to think of science in connection with it.

But it would be untrue to allege that the planters of these latter days have been wholly oblivious to the bearing of science upon their industry. They could not be altogether unmindful of what it had done for their rivals, nor without hope that it might be serviceable in their own case, and, as a matter of fact, various attempts have been made by them to help themselves by the aid of science. But they suffered under one great disadvantage as compared with European producers. Whereas Continental Governments, and especially that of Germany, fostered the industry and afforded it financial support, favouring it in a variety of ways by legislative action, the West Indian planters were left, to a large extent, to shift for themselves. Few Colonial Ministers have had the wisdom and foresight of Mr. Joseph Chamberlain. In the face of a bounty-fed system, the West Indian planters naturally lost heart, and many sugar estates went out of cultivation; other planters, owing to lack of capital and consequent inability to provide themselves with modern machinery, were brought almost to the verge of ruin. Parliament, under the influence of a fiscal policy which had no real appreciation of Imperial needs, turned a deaf ear to their complaints. It was cold comfort to be told that they were the victims of economic and industrial progress, and of the changing conditions of social development. The masses were so enamoured of the idea of a free breakfast table that they continually returned to power the politicians who misled them with that specious cry.

In the meantime, Germany was steadily maturing her plans to secure world-wide power. Her manufacturers were paid a bounty by their Government to enable them to export sugar at a lower price than the cost of production in the hope of finally ruining the Colonial planter. In 1884 German beet-sugar was first "dumped" in this country. It was useless to point out the real meaning of this action and what the inevitable consequence would be. As Mr. Heriot says, "Great Britain looked only at the immediate advantage of cheap sugar, and cared nothing about the future."

We have now had a rude awakening. It is true that the Brussels Convention of 1901–2 abolished bounties on beet-sugar by international agreement. But by that time the mischief had been done, and we had become practically dependent on Continental sugar. Germany could well afford to sign the agreement. She had largely achieved her purpose. In the year before the outbreak of the war we imported nearly two million tons of sugar, of which less than 4 per cent. was British cane-sugar. Vested interests had meanwhile grown up in this country and had acquired a certain amount of political influence, which a democratic Government was powerless to withstand. What we have suffered from this condition of things scarcely needs to be stated. We have been compelled to transfer our custom, and still to assist, at a heavy cost to ourselves, in the production of sugar elsewhere than within the British Empire. The Colonial industry has, no doubt, slightly increased its production during the war, in spite of many difficulties, and we have rewarded its efforts by taxing it on excess profits.

The whole position in regard to the future of British sugar production needs to be reviewed. The Empire is certainly capable of making all, and more than all, the sugar it requires. Sugar is, and must continue to be, partly a tropical production and partly home-grown. The sugar-cane can only be grown in the tropics and with the aid of coloured labour. In 1915 the West India Committee ascertained that certain of our Colonies and Dependencies, which now collectively produce about 880,000 tons of cane-sugar annually, could produce 4,000,000 tons if all the land suitable for the growth of the sugar-cane were cultivated. And this estimate did not include India, Egypt, and the captured German colonies.

The sugar-beet succeeds best in temperate climates, where white labour is available. But Canada is, at present, the only portion of the Empire where the beet-sugar industry has been established, although it has been conclusively demonstrated that the sugar-beet will flourish in Great Britain, in Ireland, in South Africa, and in certain districts of Australia. Up to the present no very serious attempt has been made to introduce its cultivation into England. The Cantley scheme was a financial failure, as it depended on local farmers. Another attempt is now being made at Kelham, in Nottinghamshire, under other conditions, and the Government has advanced money for the purchase of 5600 acres of land, which seems almost insignificant when compared with the 70,000 acres which Napoleon, in 1811, ordered to be planted. But everything has a beginning and we must "wait and see."

It is abundantly clear that there is an ample sufficiency of land within the Empire to supply the world with sugar if the industry were properly organised, and reasonable steps taken to ensure the supply of labour and to attract capital. As regards the tropical production of sugar, more might be done to tap the immense reservoir of labour which exists in India. Home-grown sugar can, probably, only be produced at a higher cost, but the community would gain in other ways by the establishment of a large and important industry producing many valuable by-products, and requiring much machinery and agricultural implements.

To a large extent the problem is a question of tariffs, and its satisfactory solution can be settled only by boldly facing this issue. The country must make up its mind that the era of the cheap sugar of pre-war days is at an end. People who have found it no great hardship to pay $5\frac{1}{2}d.$ per lb. for their sugar can surely be induced to pay at least half that sum, exclusive of duty, if they and their successors are assured of a continuous supply produced within the Empire.

The British Empire Producers' Organisation, which was founded in 1915 to encourage the production of foodstuffs, raw materials, and manufactured articles within the Empire, and for the welfare of the Empire as a whole, has dealt with this matter of tariffs, and its proposals include the following:—

(1) That Empire sugar be granted preferential treatment to the extent of 50 per cent. of any tariff that may be in force. This means a reduction of the duty by $\frac{1}{2}d.$ per lb.

(2) That sugar produced by our Allies be granted preferential treatment to the extent of $12\frac{1}{2}$ per cent. on the tariff in force. This corresponds with a reduction of the duty by $\frac{1}{8}d.$ per lb.

(3) That sugar produced by neutral countries should pay the full tariff without any reduction.

As regards home-grown sugar the Organisation recognises that some degree of protection will be absolutely necessary if capital is to be attracted to the new industry, and it suggests that "the difference between excise on home-grown beet-sugar and the duty on Empire-grown cane-sugar shall be 2*l.* 6*s.* 8*d.* per ton until the crop of home-grown sugar reaches 50,000 tons per annum, after which such advantage would cease."

These proposals will doubtless be fiercely opposed by all to whom the word "Protection" is anathema. But the events of the time, and the chastening influence of the conditions which have been forced upon us by the Central Powers in the effort by the most powerful of them to secure the domination of the world, have profoundly modified our views on many matters. The Government has now agreed to the principles of Imperial preference, and the policy of preferential treatment of our Allies has been embodied in the resolutions of the Paris Economic Conference.

In regard to tariffs the matter now resolves itself into a question of details, and if the nation is determined, as it no doubt is, that the disadvantage under which it has suffered shall never again arise, but that the machinations of our arch-enemy shall be effectually checkmated, once and for ever, there should be little or no difficulty in arriving at a satisfactory adjustment. T. E. THORPE.

THE MINERAL WEALTH OF GERMANY.

THE *Fortnightly Review* for June contains an interesting article by "Politicus" on "The Natural Wealth of Germany," in which particular stress is laid upon the immense value of the asset represented by that country's mineral possessions. These are tolerably accurately known, because in Germany the State owns the minerals and has therefore taken good care to have a complete and scientific inventory made of its mineral resources. The facts as to Germany's mineral riches are thus readily accessible, and ample statistical information is available on the subject. Taking the three undoubtedly most important of Germany's mineral products, namely, coal, iron-ore, and potash salts, the author of the article in question arrives at the startling conclusion that the value of these is close upon 240,000 millions sterling, out of which coal alone represents 89 per cent. A German poet has long ago warned the world that no prudent fighter underrates his foe, but it is perhaps almost as grave a blunder to overestimate his powers, and there is no difficulty in showing that this is what "Politicus" has done to an enormous extent.

It will be easiest to commence with coal, this being, as stated, by far the most important factor, whilst abundant statistics are available for discussing the question. "Politicus" takes the report submitted to the International Geological Congress in 1913, which gave the coal resources of Germany at about 400,000 million tons. He says simply that "at the very low average price of 10*s.* per ton at the pit's mouth" this coal is worth more than 200,000 millions sterling. He forgets, apparently, that this coal is not at the pit's mouth—it is deep within the bowels of the earth. The value of 10*s.* per ton at the pit's mouth may be readily accepted as a fair figure, but this is assuredly not the value of the coal in its unsevered condition. In a recent paper on the subject the writer of the present article showed that the value of coal at the pit's mouth in Great Britain amounted to about 10*s.* per ton in 1913, and that this price was made up of:—Royalty 5·35 per cent., wages 62·55 per cent., materials 16·45 per cent., administration 7 per cent., and interest and profit 8·65 per cent. It is surely obvious that it is only the first item which represents the value of the coal as it lies in the ground, and that out of the value of 10*s.* at the pit's mouth 9*s.* 6*d.* represents the cost of getting and raising it, so that its real value is only the balance of 6*d.* Certain American figures also quoted by the author of the article show that the royalty value of the coal—that is, the value of the coal as it lies in the seam—is less than 4 per cent. of its cost at the pit's mouth in the United States, so that the figure of 5 per cent. of the value at the surface here adopted may be considered to represent very closely the general value and can be applied to the German conditions without much risk of error. Hence, so far, the figure given by "Politicus" would appear to be twenty times too great, and his 200,000 millions would be reduced to 10,000 millions.

Even this latter figure is, however, a great overestimate, and that for a reason that "Politicus" has also overlooked. It has been seen that coal in the unsevered condition is worth 6*d.* per ton, but this 6*d.* is realisable only as and when the coal is won. A ton of coal that is to be won a century from now is worth to-day, not 6*d.*, but only 0·0456*d.*, or less than the twentieth part of a penny, allowing interest at 5 per cent. This quite obvious consideration, that a sum of money, receivable at a distant date, is worth to-day only the amount which, if allowed to accumulate at interest, would produce the sum in question, must profoundly influence the present value of coal to be won at a remote date, but it has been entirely omitted from the calculation. It is true that it is only possible to compute the present value of Germany's coal reserves by making a series of assumptions, yet by means of these we are able to determine, at any rate, the order of magnitude of the figures involved. In 1913, the coal production of Germany was about 150 million tons; if it be assumed that this increases by 50 million tons annually, the production in a century would be at the rate of 5150 million tons per year, and the total quantity worked during the century would be 265,000 million tons, or more than half the known coal resources of the country. No one can possibly predict what the coal production of any country will be a century hence, but, so far as anyone can see, this rate of increase of production is much greater than what the actual increase can reasonably be expected to be; it follows that the present value of the coal resources is greater on this hypothesis than it is in reality, even though the value of all the production after the first century be neglected. The value of the coal produced during the century at 6*d*. per ton, allowing money to earn interest at the rate of 5 per cent., is only about 550 millions sterling to-day, and though it is impossible to assert that the coal resources of Germany are really worth this amount, it is tolerably evident that they cannot be worth more. In other words, the estimate of "Politicus" is nearly 400 times too great.

Turning next to the iron-ores, the author puts the quantity at 4000 million tons, and he values these at 5*s*. per ton, apparently also at the mouth of the mine, and thus gets at a value of 1000 millions sterling. Fully 80 per cent. of Germany's iron-ore production comes from the minette ore-field of Lorraine and Luxemburg, and as this field is tolerably well known and much information has been published about it, it will suffice to confine the discussion to this field alone. "Politicus" has taken his figures from those published at the International Geological Congress in 1910, but these are now out of date, and more accurate data are to-day available. According to the most recent estimates by the leading German authority, the available minette ore in the Luxemburg-Lorraine ore-field amounts to about 2090 million tons. In 1913, the output was approximately twenty million tons, and it has been increasing at the rate of about two million tons per annum. Assuming a uniform rate of increase up to the exhaustion of the field, which, though technically impossible, is a convenient hypothesis for the purposes of calculation, and will assign to the ore-field a value in excess of the facts, the field would be worked out in about thirty-seven years, the output in the last of these years being calculated at ninety-two million tons. The estimate of value given by "Politicus" is certainly wrong; these ores cost at the mine about 2*s*. 6*d*. to 3*s*., 3*s*. 6*d*. being considered a high figure. The value of the ore *in situ* must accordingly be low, though there are no data at hand for accurately determining this; a valuation based on English conditions would assign to it a value of 3*d*. to 4*d*. Taking the higher figure, and again capitalising at 5 per cent., the present value of this iron-ore field on the above assumptions comes to rather more than 12½ million pounds. If the discount on the value of the ore to be won in later years had not been taken into account, an erroneous value of close upon thirty-five million pounds would have been arrived at. Taking 3½ millions sterling as the value of the other iron-ores of Germany, a total of sixteen million pounds is arrived at, and the figure given by "Politicus" is thus sixty times too great; the error is less in this case than in that of coal, because the period of exhaustion has been assumed to be much shorter, and the present value, corresponding with the production at the end of the term, is correspondingly higher.

The third material discussed as a source of mineral wealth is the series of potassium salts derived from the vast deposits of which Germany owns the practical monopoly. Here there are no safe data available for determining the value. The writer in the *Fortnightly Review* assumes that the supplies amount to 50,000 million tons and that they are worth 10*s*. per ton; as before, he has confused value at the mouth of the mine with value *in situ*, and has made no allowance for discounting the sums realisable only at a distant date. It is therefore probable that his figures are several hundred—say, at least 200—times too high, and that 125 million pounds is a more probable estimate of the true present value than the figure given by him.

Thus a correct method of appraising mineral values shows that the figure of nearly 240,000 million pounds sterling, given by "Politicus" as the actual value of the three most important items of the mineral wealth of Germany, must be reduced to under 700 millions, so that the former figure is roughly 300 times too great. It need scarcely be repeated that the numbers here arrived at make no pretence to accuracy, but they do probably indicate the correct order of magnitude of the present value of these minerals, and, in any case, they serve to show the correct method of valuing minerals in their unsevered condition.

H. LOUIS.

ANTHRAX AND ITS PREVENTION.[1]

ANTHRAX is an acute, infective disease of man and animals and is caused by the anthrax bacillus, which becomes disseminated throughout the body so that every part is infectious. The many animal products used in commerce may thus be a grave source of danger if they emanate from animals which have succumbed to the disease. Although in this country anthrax is not to be regarded as a frequent cause of death, it is nevertheless of great importance on account of the increase which has taken place, and especially in virtue of the very large amount of material imported from countries where anthrax is rife. In order to prevent the disease in dangerous trades working with possibly infected animal material it would, at first sight, appear to be a simple thing to disinfect the infected material. In practice, however, this is found to be exceedingly difficult on account of the truly enormous powers of resistance of the spore of the anthrax bacillus, which is among the most remarkable of living things. A method to be efficient and practicable (1) must aim at the complete destruction of the infectivity of the material; (2) must not damage the material; (3) must be practicable on a large commercial scale; and (4) its cost must be reasonable.

[1] Report of the Departmental Committee Appointed to Inquire as to the Precautions for Preventing Danger of Infection by Anthrax in the Manipulation of Wool, Goat Hair, and Camel Hair. Vol. i., Report of the Disinfection Sub-committee. (London: Published by His Majesty's Stationery Office, 1918.) Price 1*s*. net.

Hitherto all methods have failed in one or other of these essentials. The report before us, however, contains a large body of accurate experimental evidence which goes to show that complete success can now be attained without risk to the workers and without damage to the material disinfected. The main feature of the process is a preliminary treatment in which material is submitted to the action of a warm solution of soap and water containing alkali, followed by squeezing through rollers. This causes softening and disintegration of any infected blood-clots, and the spores are laid bare for the subsequent destroying process, which is carried out by a warm solution of formic aldehyde. The material, after being again squeezed through rollers, is then dried and kept for a short time as an extra safeguard. According to the testimony of practical people the hair and wool are not injured by the process, and it is computed that ten million pounds of infected wool can be effectively disinfected for something less than 0·824 penny per pound weight.

The report is a brilliant instance of how preventive measures in medicine must be based on scientific inquiries, and it is not too much to expect that "wool-sorter's disease" may soon disappear from the list of the fatal maladies of man.

NOTES.

THE Bellahouston gold medal has been awarded by the University of Glasgow to Dr. R. T. Leiper, of the London School of Tropical Medicine, whose researches on Bilharzia disease in Egypt are well known.

THE David Syme research prize for 1918, consisting of a medal and 100*l.* for any scientific research in Australia during the last five years, has been awarded to Dr. T. Griffith Taylor for a thesis based on the correlation of Australian physiography, meteorology, and climatology, with special reference to the control of its settlement and industrial development.

MR. WILLIAM PERREN MAYCOCK, who died on June 29, was the author of many text-books and popular works on electrotechnics. Some of his works, as, for instance, his treatise on "Electric Lighting and Power Distribution," ran through many editions. Mr. Maycock took endless pains to present the subject clearly and correctly, and always welcomed criticism. He practised as a consulting engineer, and had been technical editor to the Westinghouse Companies' publishing department in Europe.

CANON RAWNSLEY, in a letter to the *Times* for June 28, stated that the War Office contemplated the draining of Wolmer Pond, near Liss, Hampshire, "in order to grow wheat on its sandy bottom." The pond is a natural feature of great interest, and it is closely associated with the natural history observation of Gilbert White of Selborne. We are glad to learn, therefore, in reply to an inquiry at the War Office, that it has been decided not to proceed with the draining of the pond. The Selborne Society has received the same intimation from the Secretary of State for War in reply to a petition submitted by the council of the society.

SIR J. J. THOMSON, Prof. W. H. Bragg, and Dr. W. Coolidge have been elected honorary members of the Röntgen Society. The following officers of the society have been elected for the ensuing year:—*President:* Dr. G. B. Batten. *Vice-Presidents:* Mr. J. Hall Edwards, Prof. A. W. Porter, and Dr. Dawson Turner. *Members of Council:* Mr. C. A. Clarke, Mr. N. S. Finzi, Mr. W. Hampson, Mr. C. Howard Head, Mr. C. R. C. Lyster, Dr. J. Metcalfe, Prof. J. W. Nicholson, Dr. G. H. Rodman, Mr. W. E. Schall, Mr. E. S. Worrall, Mr. E. P. Cumberbatch, and Dr. V. E. A. Pullen. *Honorary Treasurer:* Mr. Geoffrey Pearce. *Honorary Secretaries:* Dr. Robert Knox and Dr. Sidney Russ. *Editor of the Journal:* Mr. W. F. Higgins.

LORD HYLTON announced in the House of Lords on July 2 that it is proposed to recommend to the King that a Royal Commission should be appointed at an early date, consisting of members of both Houses of Parliament and other persons with special qualifications, to consider the question of the desirability or otherwise of making a change in our coinage system. The terms of reference will be to consider the proposal embodied in the Bill which was recently introduced by Lord Southwark in the House of Lords. The Commission, if it decides in favour of a change, may either adopt the proposals contained in the Bill or make any other proposals. It will be able to put forward its recommendations in the form of a draft Bill.

IN connection with the Food Economy (Plants) Exhibit at the Natural History Museum, South Kensington, an explanatory leaflet has been prepared giving an outline of the basal principles of nutrition and the characteristics of the common foodstuffs. The information is conveyed in simple terms now familiar to the general public, and should add greatly to the educational value of the exhibit. In a popular exposition of scientific knowledge on this subject it is impossible to avoid a certain degree of looseness of expression, which the physiologist or agricultural chemist might feel disposed to criticise. It is scarcely correct, for instance, to describe malt as "fermented barley." On the whole, however, the information is correct and in accordance with current scientific teaching, and in no case can it be described as actually misleading.

THE list of pensions granted during the year ended March 31, 1918, and payable under the provisions of the Civil List Act, includes the following names:—Mrs. Mann, in consideration of the valuable services of her late husband, Mr. R. F. Mann, to science and medicine in the development of radiography, in the course of which he received injuries which resulted in his death, 120*l.*; Mrs. Judd, in consideration of the services of her late husband, Prof. J. W. Judd, to geological science, 75*l.*; Mrs. Rippon,, in consideration of the valuable services rendered by her late husband, Mr. R. F. H. Rippon, to natural history and science, 50*l.*; Miss Bertha Couch, in consideration of the scientific eminence of her late father, Dr. Jonathan Couch, naturalist, ichthyologist, and author, 40*l.*; Mrs. Vaughan, in consideration of the scientific eminence of her late husband, Dr. Arthur Vaughan, geologist, 40*l.*; Mrs. Coffey, in consideration of the value of the researches and writings of her late husband, Mr. George Coffey, curator of the Dublin Museum on Irish archæology, 30*l.*

A GROUP of botanists in the United States has arranged for the publication of a monthly journal of botanical abstracts, botany to be interpreted in its broadest sense. The prime purpose of *Botanical Abstracts* is to supply prompt citations and abstracts of all papers dealing with botanical subjects, wherever published, as soon as possible after they appear. The editor-in-chief is Dr. B. E. Livingston, Johns Hopkins

University, Baltimore, and there are fifteen associate editors in the United States for particular sections of botanical science. Sectional editors are being appointed for other countries, and Dr. Marie Stopes has accepted the British editorship in palæobotany for the new journal. Dr. Stopes will be glad if all British (including the Colonies and Dominions) authors of papers dealing with palæobotanical subjects will send her on publication the titles, volumes, and exact page and plate references of their publications, followed by reprints as soon as they are available. Work from January, 1918, is wanted at once. Address to Dr. Stopes at University College, London, W.C.1.

THE Norwegian North Polar Expedition under the leadership of Capt. Roald Amundsen was to leave Christiania last week, and is expected to be absent for about five years. According to the *Times*, the *Maud*, the vessel of the expedition, will call at Bergen and Tromsö, and will proceed thence to Novaya Zemlya. The Kara Sea will be crossed, and the *Maud* will call at Dickson Island, at the mouth of the River Yenesei, to take on board 225 gallons of oil. From the wireless station at Dickson Island the latest news of the expedition may be expected. Skirting the north coast of Asia, the *Maud* will turn northward on the east of the New Siberia Islands and enter the polar pack about September. In 1893 the *Fram* entered the pack west of the New Siberia Islands. Amundsen, by starting from further east, hopes to drift parallel to the *Fram* across the North Polar Basin, but further north. He does not expect to touch continental land during the drift of the *Maud*, although he believes in the existence of a considerable amount of land north-east of Alaska. There is little news so far of ice conditions in polar seas this year, but they were reported to be favourable in Spitsbergen waters in June, and it is hoped that the crossing of the Barents Sea will present no difficulties. July is an early month for navigation in the Kara Sea, and the *Maud* will doubtless encounter difficulties there, but Amundsen's early start is a wise choice, since August and September are good months for the navigation along the north coast of Asia.

WE learn from *Science* that President Wilson has issued a proclamation establishing three new national forests in the East United States—the White Mountain, in Maine and New Hampshire, the Shenandoah, in Virginia and West Virginia, and the Natural Bridge, in Virginia. Proclaiming the forests is the final step in carrying out the law for building up eastern national forests through the purchase of lands in the mountains. The Pisgah National Forest, in North Carolina, and the Alabama National Forest, in Alabama, are the only eastern areas which had received this status before the new proclamations were issued. The White Mountain National Forest is located in Grafton, Carroll, and Coos Counties, N.H., and Oxford County, Me. There is now a total of about 391,000 acres under Federal protection. This forest protects in part the watersheds of the Androscoggin, Saco, Connecticut, and Ammonoosuc rivers. The Shenandoah National Forest is situated in Rockingham, Augusta, Bath, and Highland Counties, Va., and Pendleton County, W. Va. Here there is a total of approximately 165,000 acres under Federal protection. The forest is for the most part on the watershed of the Shenandoah River, and it also protects a portion of the watersheds of the Potomac and the James. The Natural Bridge National Forest of 102,000 acres is situated in Rockingham, Nelson, Amherst, Botetourt, and Bedford Counties, Va. The forest, which protects a portion of the watershed of the James River, does not include the Natural Bridge, but this scenic feature is within three or four miles of the boundary.

WITH the double object of encouraging the Irish agriculturist to greater effort, and of making the facts better known in Great Britain, the Department of Agriculture and Technical Instruction for Ireland has issued a short leaflet giving a concise exposition of the part played by Ireland as a food supplier of Great Britain. For many years prior to the war the supply of food from Ireland to Great Britain steadily increased, until by 1913 it was exceeded only by that from the United States. Since the war the Irish supply has continued to increase, and, taking into account quantity, character, and proximity, must now be regarded as our most important supply. Comparison of the exports of foodstuffs from Ireland to Great Britain for the years 1912–13 and 1916–17 shows a decrease only in pig-products, dairy produce, and poultry, all items which have been detrimentally affected by the reduction of the import into Ireland of feeding-stuffs from abroad. The export of livestock to Great Britain has been more than maintained despite this reduction of imported feeding-stuffs and the breaking up of extensive areas of grass; while, in addition, Ireland has supplied very large quantities of potatoes, oats, hay, and straw to Great Britain and to the Army. Ireland produces 40 per cent. of the cattle and 30 per cent. of the pigs of the United Kingdom. She consumes only one-fourth of her own cattle. She is thus, in an increasing degree, Great Britain's nearest and greatest food base. An explanation is given of the meaning of certain Orders regulating exports from Ireland which have aroused adverse comment in Great Britain. It is maintained that these Orders were designed for the common interest of the United Kingdom, and were necessary to secure that the best possible use should be made of Irish resources.

WE regret to announce the death, after a long illness, of Prof. K. Toyama, professor of zoology in the University of Tokyo. Born in 1867, Prof. Toyama graduated from the College of Agriculture, Tokyo University, in 1892. After graduation he devoted himself to the study of the silkworm, the foundation of a most important Japanese industry. His earlier work dealt chiefly with the spermatogenesis and embryology of these insects, though he also published papers on their habits and the parasites attacking them. With the re-discovery of Mendel's work he commenced a series of experiments designed to elucidate the various characters distinctive of different breeds. During the progress of this research he spent several years working in the laboratory of the Royal Siamese Sericultural Department in Bangkok. The first instalment of his results appeared as a long and important paper in 1906—a paper which was the first of a series devoted to the unravelling of the genetic constitution of the various races of the silkworm. Later on he succeeded in clearing up the apparent inconsistencies in the hereditary behaviour of white and yellow colour in the silk which had puzzled other observers. He was able to prove the existence of two different kinds of white, one dominant and the other recessive to colour, a point of scientific interest as well as of considerable practical importance. One of his last pieces of work was the elucidation of certain peculiar phenomena in the transmission of egg-colours in the silkmoth, and he was able to show that these are comparable with those observed in connection with the seed characters of many plants. To zoologists, perhaps, his name is best known in association with some remarkable gynandromorphs of the silkworm and moth which were bred and described by him, for, owing to their important bearing on the problem of sex-determination, they at once received recognition as classical cases.

An interesting account of the luminous moss *Schistostega osmundacea*, Mohr, is given by Mr. G. T. Harris in the Journal of the Quekett Microscopical Club (vol. xiii., April, 1918). The luminosity is due to certain cells of the protonema, which, as pointed out by Noll in 1887, are so constructed that the light rays falling upon them are refracted through the transparent sap and concentrated upon the chlorophyll grains which are grouped at the base of the cell. Owing to the shape of the cell, the light rays are totally internally reflected from the basal walls and again emitted, which gives the luminous appearance. The moss appears to be widely distributed in the British Isles. It seems to prefer a habitat with a northerly aspect, and apparently thrives best in granitic areas. The light-cells are differentiated on the protonema, and are spread out in an irregular superficial layer over the underlying protonemal filaments, which are bipinnately branched. The fruit is somewhat rare, but when it occurs it may be abundant. The distribution of the plant is aided by the deciduous spore-capsules and by an abundance of gemmæ formed on the protonema, especially when barren conditions of the plant prevail.

Researches carried out by Dr. Lewis H. Weed in the anatomical laboratory of the Johns Hopkins University have thrown a flood of light on the origin and nature of the fluid system which surrounds the central nervous system of vertebrate animals. Dr. Weed was successful in replacing the cerebro-spinal fluid in living pig embryos by a ferrocyanide solution, and was thus able by the deposition of Prussian blue to discover a series of unknown stages in the elaboration of the space in which this fluid is contained. In the first month of development, up to the stage in which the pig embryo has attained a trunk-length of 14 mm., the cerebro-spinal fluid is confined to the central canal of the nervous system. At that stage of development the roof of the fourth ventricle of the brain becomes thin and membranous; chorioid villi for the secretion of the fluid become developed, and fluid begins to appear in the tissue spaces outside the roof of the fourth ventricle. That accumulation over the roof of the fourth ventricle represents the first stage in the development of the sub-arachnoid spaces. From the roof of the fourth ventricle the sub-arachnoid system gradually spreads out, and by the time the pig embryo has attained a trunk-length of 26 mm. the system has reached the limits of the extensive ramifications to be seen in the adult animal, in which the spaces surround both spinal cord and brain. It is thus clear that the sub-arachnoid spaces are not parts of the lymph system, but are extensions of a special system developed as extensions of the central canal of the nerve axis. The aqueous chamber of the eye and perilymphatic spaces of the inner ear are systems of a similar kind. Dr. Weed was successful in finding further and convincing evidence of the secretion of cerebro-spinal fluid by the chorioid plexuses and of its absorption into the great venous sinuses of the dura mater by a special mechanism, represented in the adult by the Pacchionian villi. Much still remains to be done before the exact uses of the cerebro-spinal fluid are determined. Dr. Weed's researches have been published in full by the Carnegie Institution of Washington (Contributions to Embryology, vol. v., No. 14, 1917).

In Bulletin No. 28, entitled "The Soil Solution Obtained by the Oil-pressure Method," issued by the Michigan Agricultural Experiment Station, it is pointed out that the study of the liquid phase of the soil might yield much valuable information as regards soil fertility if a satisfactory method of obtaining a representative sample could be devised. An oil-pressure method is recommended, in which paraffin oil is forced through the soil enclosed in cylinders, thus displacing the soil solution. The physical and chemical properties of successive portions extracted from a given soil were found to vary very little, the greatest variation occurring in the nitrogen compounds, especially in the ammoniacal and nitrate nitrogen; the total nitrogen, however, did not change. From different soils the extracts differed; soil treatment and reaction cause considerable variation in potassium, calcium, magnesium, and especially nitrogen; phosphoric acid varies only slightly.

At the present time the use of electric furnaces is spreading rapidly in this country. In view of their further possibilities, the need for researches on the production and application of high temperatures is urged by Mr. C. R. Darling in an article contributed to the Journal of the Society of Chemical Industry for May 31. To emphasise the point as regards electric furnace research, the writer notes what has already been achieved by its use in transforming certain common materials. Coke and lime give calcium carbide, which in turn yields acetylene and cyanamide. Coke and sand give carborundum, an abrasive now used throughout the world; and the fusion of bauxite gives another abrasive, alundum, which has practically superseded other materials for the grinding of steel. Amorphous carbon yields graphite, which is now invaluable in electrolytic processes, and has proved to be the best material for filling dry voltaic cells. These products have revolutionised many industries, but they represent only the beginning. Investigations are needed, for example, on the conditions under which tungsten could be melted on a reasonably large scale, and valuable results might be expected from a study of the possible alloys obtainable from tungsten, tantalum, and molybdenum. Research work of the character required is being carried out in America, but practically nothing has been done in this country, though a start is being made at Sheffield University by the erection of an electric furnace for experiments on steel. The practicability of producing high temperatures by the combustion of gases under pressure is also a matter for investigation; Sir Robert Hadfield has recently directed attention to some early experiments of Bessemer in this direction.

In the Metropolitan Museum of Art, New York, is the tomb of Perneb, originally erected at Memphis about 2650 B.C. Mr. M. Toch has had an opportunity of analysing the pigments used on the tomb, and gives an interesting account of them in a paper quoted by the *Chemical News* of June 7. The pigments are red, yellow, blue, green, grey, and black. The usual idea that the red used by the Egyptians was red ochre appears to be erroneous; the red found in this instance proved to be hæmatite, which contains much more iron oxide than the ochres. All the yellows used on the tomb were composed of the native ochre, which is clay coloured with iron-rust. The Egyptian blues are beautiful colours, ranging from a light sky-blue to a dark ultramarine. A microscopical examination of the dark blue showed it to be of the nature of a powdered "smalt" glass or porcelain; this powder has been rubbed into the pigmented surface and allowed to set with Nile clay or mud, which, being slightly alkaline, acts as a cement, and has both setting and binding properties. A greenish-blue pigment examined was composed of azurite, a hydrated carbonate of copper; whilst the green pigment was a mixture of malachite, azurite, and clay. The grey was limestone mixed with charcoal or carbon, and the black was a carbon black, composed of charred wood or burnt bones. It has been generally assumed that the Egyptians used white of egg as a binder for their pigments, but Mr. Toch could find no trace of any albuminous binder in the specimens submitted to him; they did, however, show evidence of the use of glue or gelatin. The pigment in two paint-pots, evidently thrown away by the workmen, was found to be hæmatite mixed with limestone and clay.

A REPORT of Prof. W. J. Pope's recent presidential address to the Chemical Society, which is comparable in importance with the late Prof. Meldola's address of eleven years ago, is printed in the April issue of the society's Journal. Prof. Pope commences his address —entitled "The Future of Pure and Applied Chemistry"—by pointing out that the last three years have dissipated for ever the fallacy that British chemists cannot excel in applied organic chemistry. In fact, Great Britain, which in 1914 had no resources for their manufacture, is now a larger producer of explosive, pharmaceutical, photographic, and other essential chemicals than Germany. The fact that science is unvocative has prevented the people from realising that the discoveries of Young, Davy, and Dalton at the beginning of the nineteenth century had more influence than the Napoleonic wars. The whole history of Europe for the last century was made within the laboratories of the Royal Institution. The greatest incentive to political change is the desire to increase the amenities of life, and research in pure science has for a hundred years been the greatest influence in this direction. Prof. Pope strongly urges that the various chemical societies should set up a joint council for the consideration of national questions in which chemical interests are concerned, and suggests for its consideration the correlation of the dye interests with the synthesis of pharmaceutical and photographic products, the development of natural colouring matters, and the study of patent law.

SOME interesting examples of the work accomplished by the Salvage Section of the Admiralty are given in *Engineering* for June 21. Since October, 1915, down to the present time about four hundred ships have been salved by this department. A large proportion of these ships, some of which are of high carrying capacity, has been repaired, refitted, and put in commission afresh. On account of the comparative shortage of shipping it is worth while at the present time to salve practically every sunken ship, whereas before the war many would have been left to their fate on account of the cost of the operation exceeding the value of the ship. One of the great aids to salvage operations is the submersible electric-driven motor-pump, some types of which can deliver 500 tons of water per hour to a height of 75 ft. to 80 ft. One of the examples quoted is that of a vessel carrying a cargo of foodstuffs to the combined value of more than 3,000,000*l*. After being torpedoed, she was taken in tow by the Section's tugboats, but sank before she could be left high up on the beach. Electrically driven submersible pumps were put down in the stokeholds and divers established communication between the flooded holds and the stokeholds. After making the parts thus involved watertight on the outside the pumps were started, and the vessel, being thus lightened, could be drawn higher up on the beach, when similar operations were effected in the lower submerged quarters. The vessel was ultimately floated off and repaired.

IN a recent issue of the *Zeitschrift für angewandte Chemie* is described a process (patented in Germany) for spraying metals on to any kind of surface, using metal melted in an electric arc and blown by means of gas-jets on to the surface to be covered. The metal to be sprayed forms one of the electrodes of the arc, and the gas-jets are directed so as to strike the sides of the metal electrodes without impinging on the arc and blowing it out. If the arc is produced between two electrodes, one being metallic, and a stream of non-oxidisable gas is directed on to the electrode, portions of the electrode that are melted will be carried away in the form of a fine spray, and may be deposited on any surface on which they impinge, thus forming a metallic skin on it. Suitable control apparatus is provided to allow for the wear of the electrodes.

WE have received a Classified List of Publications of the Carnegie Institution of Washington, dated December, 1917. It is stated that copies of each publication, except the Index Medicus, are sent gratuitously to each of the greater libraries of the world, while the remainder of the edition is to be sold at prices sufficient only to cover the cost of publication and postage. Among the volumes published by the institution in 1916 and 1917 we notice:—In astronomy, a revision of Ulugh Beg's Persian Catalogue of Stars by E. B. Knobel; in mathematics, a Sylow Factor Table of the first twelve thousand numbers by H. W. Stager; in chemistry, "The Interferometry of Reversed and Non-reversed Spectra," by Carl Barus; in terrestrial magnetism, "Ocean Magnetic Observations, 1905–16," by L. A. Bauer; in palæontology, "American Fossil Cycads," by G. R. Wieland, and "The Coal Measures Amphibia of North America," by Roy L. Moodie; in embryology, two new volumes of the "Contributions to Embryology," by various authors; in evolution, "Studies of Inheritance in Guinea-pigs and Rats," by W. E. Castle and S. G. Wright, "Gonadectomy in Relation to the Secondary Sexual Characters of some Domestic Birds," by H. D. Goodale, and "Sex-linked Inheritance in Drosophila," by T. H. Morgan and C. B. Bridges; in botany, "Plant Succession," by F. E. Clements; and in zoology, a new volume of papers from the Department of Marine Biology of the Carnegie Institution. It will be seen that the works recently published by the institution belong, as in former years, to many different branches of science. The complete list contains about 264 volumes published since 1903, with short descriptive notes on most of these publications.

MESSRS. BLACKIE AND SON, LTD., will shortly publish "Medicinal Herbs and Poisonous Plants," by Prof. David Ellis, of the Royal Technical College, Glasgow.

OUR ASTRONOMICAL COLUMN.

A NEW ASTEROID OF THE TROJAN GROUP.—A fifth member of this group has been discovered by Wolf. It has at present only the provisional designation CQ. The following elements are given in *Ast. Nach.*, No. 4945:—Epoch 1917, September 24.5, G.M.T., M $83° 18' 55''$, ω $329° 32' 38''$, Ω $300° 41' 27''$, i $8° 51' 26''$, ϕ $6° 46' 53''$, μ $294{\cdot}427''$, $\log a$ $0{\cdot}720686$. CQ and Patroclus are about 60° behind Jupiter in longitude, while Achilles, Hector, and Nestor are 60° in front of Jupiter. The value of μ for each of them oscillates about $5''$ on each side of the value for Jupiter $299''$, the period of an oscillation being

150 years. CQ had its minimum value of μ about 1911; it will reach the mean value in 1949 and the maximum value in 1986. Its phase in this libration appears to be nearly opposite to that of Patroclus, so that the two planets are on opposite sides of their librational ellipse.

A FAINT STAR WITH LARGE PROPER MOTION.—In the *Ast. Nach.*, No. 4944, Dr. Max Wolf announces the discovery that a 13th magnitude star, about 2° west of χ Leonis, has the exceptionally large proper motion of nearly 5″ per annum. The star appears on plates taken with the Bruce telescope at an interval of 17·055 years, and the following co-ordinates for 1875·0 have been determined from neighbouring comparison stars:—

	R.A. h. m. s.	Decl. ° ′ ″
1901·146	10 50 24·40	+7 45 21·8
1918·201	10 50 20·00	+7 44 36·7

These measures give the proper motion as 4·66″ in the direction 235·4°, in close agreement with 4·84″ in the direction 232° determined by the stereo-comparator. In the period covered by the observations the total motion of the star was 1·4′.

THE YOUNG MOON SEEN AS A CIRCLE.—Miss E. A. Stevenson has directed attention to the interesting appearance which the moon occasionally presents when about two days old (Journ. Brit. Ast. Assoc., vol. xxviii., p. 223). Besides the familiar earth-shine effect, the "dark" limb of the moon then appears as a ring of silver light, in continuation of the illuminated crescent. When observed by Miss Stevenson, the circle has always been complete, but never of uniform brilliance, and its whiteness was in striking contrast with the pink or ashy hue of the earth-shine. Mr. W. Goodacre points out that the ring is best seen when the earth-shine is most marked, and attributes the appearance to the greater brightness of the moon's surface near the eastern limb as compared with the adjacent regions. The presence or absence of a similar effect along the western limb just before new moon does not appear to have been noted.

PARALLAX OF THE BARNARD STAR.—A new determination of the parallax of this star has been made at the Dearborn Observatory (*Ast. Journ.*, No. 734). The value found is 0·557″±0·016″, which is somewhat larger than the other photographic determinations.

A JAPANESE METEORITE.—Mr. Kuni Niinomi, writing from the South Manchurian Middle School at Mukden, China, sends us particulars of a meteoric stone which was observed to fall on January 25 last, at 2.28 p.m., in Central Japan, the locality being near the village of Tané, in the prefecture of Shiga, on the east side of Lake Biwa, province Omi. There was an explosion and something was heard to fall, and through a hole in the snow the stone was found at a depth of a foot in the ground. It is irregularly wedge-shaped, and covered with a black crust with the usual "thumb-markings." The greatest dimension is 86 mm., and the weight 311·16 grams, specific gravity 3·55. On the fractured surface the stone is grey, with brown spots and minute spangles of metal. In character the new stone is very similar to those of the shower which fell on July 24, 1909, near the town of Gifu, in province Mino (adjoining province Omi). The latter consist of olivine and bronzite, with very little nickel-iron, and were classed as a "white chondrite." These two falls are to be added to the list of sixteen falls of meteorites, mostly stones, recognised by K. Jimbō in 1906 in his "General Notes on Japanese Meteorites."

THE NEW STAR IN AQUILA.

THE following estimates of magnitude of Novæ Aquilæ have been communicated by Mr. Harold Thomson, who independently detected the star on June 8:—

Date	G.M.T.	Mag.	Date	G.M.T.	Mag.
June 8	11.45	0·74	June 19	11.15	2·10*
	13.30	0·74	20	11. 0	2·35*
9	9.50	−0·42	22	9.59	3·01*
	10.30	−0·26		10.47	2·87
	11. 0	−0·50		11.30	2·84
10	9.40	0·07*	23	10. 5	3·12
	12.10	−0·25		10.21	3·21
	12.45	+0·07	24	10. 0	3·1
11	10. 8	0·30	25	9.25	3·04
	10.50	0·55		11. 0	3·09
	11.45	0·43		11.20	3·10
14	13.30	1·04		12.15	3·24
15	9.38	1·55		12.35	2·99
	10.56	1·60	26	10.10	3·4
16	11.25	1·80*		11.20	3·3
18	11.10	1·90		12.30	3·4

The magnitudes marked with an asterisk were not considered very satisfactory on account of clouds or twilight. Making due allowance for these, the decline of the star does not appear to have been accompanied by any marked fluctuations.

Several early observations of the new star, made on June 8 and 9, are reported in the ephemeris circular of the *Ast. Nach.*, 1918, No. 548. The first information received by the Centralstelle was from Prof. L. Courvoisier, who had observed the star at Babelsberg on June 8 at 12h. 38m. G.M.T.; the magnitude at 13h. 30m. was given as 1·1, and the spectrum was stated to show bright and dark lines. Prof. Schorr states that a photograph taken with the reflector at Bergedorf on June 10 showed no trace of nebulosity in the vicinity of the nova. According to a telegram from Dr. Gautier, *via* Copenhagen, the new star was observed by Prof. Laskovski at Geneva on the evening of June 7, but no mention is made of its magnitude.

The spectrum of the new star has undergone considerable changes as compared with the observations previously reported in NATURE. On June 29, when the star had diminished in brightness to about magnitude 4, Prof. Fowler observed that while the bright hydrogen lines were still the predominant feature, they had become very broad, and each appeared to have a central dark line, as if reversed or doubled. In the case of H_α, there was no marked difference in the intensities of the two components, but the less refrangible component of H_β was distinctly the brighter. The total breadth of the bright H_β was estimated at not much less than 40 A. The band about λ 464 was broad and bright, but not so strong as H_β. Of the group of lines less refrangible than H_β, 492, 517, and 532 had considerably diminished in intensity, but 502 had not faded at the same rate, and was the brightest of the four. All these were very broad, and possibly double or reversed like H_β. The dark bands and the adjacent bright bands about 560 and D were still visible, and the bright D band was divided centrally by a dark line. There was also a broad, faint band about λ 600, and a narrower band about λ 631. The relative brightening of 502 may possibly indicate the incoming of the adjacent nebular line 5007.

Father Cortie informs us that further photographs of the spectrum were obtained at Stonyhurst on June 29 and 30. The chief features on these plates are the broad bright bands of hydrogen and the band about λ 464. Other bright bands are also present, but no dark lines were apparent in the preliminary examination. The band at λ464 appears double, and is fringed by a band of lower intensity on its less refrangible side. On June 30 the nova was considered to be visually equal to β Scuti, which is of magnitude 4·5. The colour of the star was brick-red.

THE METEOROLOGICAL UNIT OF PRESSURE.

A MEMORANDUM recently circulated by Prof. C. F. Marvin, Chief of the U.S. Weather Bureau, raises the question of an appropriate unit of pressure, especially for meteorological usage. The measure of pressure by a barometric height, in millimetres or inches of mercury, even when reduced to standard temperature, is not an absolute statement at all, for its meaning depends on the local value of gravity. On the other hand, the C.G.S. measure of one megadyne per square centimetre, besides being absolute, happens to express quite closely the mean atmospheric pressure at about 100 metres above sea-level. The advantage that could be taken of this fact has long been obvious; it is referred to in early editions of Everett's "C.G.S. Units," and so long ago as 1888 the adoption of the unit of pressure as one dyne per square centimetre, under the name of a *barad*, was recommended by a committee of the British Association. But nothing very definite followed; and Prof. Marvin gives the history, which is not without its moral, of the way in which the natural appropriateness and utility of this unit re-noticed, reported upon, or brought into partial use upon inconsistent systems by Guillaume, Bjerknes, and various others, including international committees.

All this most people will be content to forget, if possible, but two or three simple cardinal points remain, and an appeal is made that we should assess them and settle down to uniformity of practice for the future. The first of these is: Can one unit be adopted for the whole range of physical, including meteorological, pressures, from high vacua to extreme compression, with the help only of the familiar C.G.S. prefixes of *mega-*, *milli-*, *micro-*, and convenient numerical factors? Secondly: What is this unit? Is it a dyne or a megadyne per square centimetre? Thirdly: How far, up to the present, has actual practice gone to fix and ratify the answers to these two questions? Finally: What is the name to be?

On these points meteorologists, at any rate, may be said to have made up their minds. The *bar*, of 10^6 dynes per square centimetre, is to be the unit. One millibar is approximately equal to the pressure of 0·75 mm. of mercury, and the mean atmospheric pressure is approximately 1000 mb. or 1 bar. One-tenth of a millibar is not far from the accuracy with which the barometer can be read. The range of the barometer is included within 100 mb. In increasing degree in recent years the unit has been brought into use in the publications of the British, French, and United States meteorological services. One may say that it would now be very difficult to dislodge the millibar from meteorological use. In supplement, Prof. Marvin has prepared a table that shows that it is entirely convenient for expressing the range of physical pressures from very high vacua at 0·01 microbar to pressures of a megabar, at, say, the bottom of the ocean; while the dyne per square centimetre, which the C.G.S. system first offers, entails a much more cumbrous set of factors.

If there are any substantial objections to the bar of one megadyne per square centimetre as the unit of pressure—and there do not appear to be any—the wide acceptance it has already won in use should go far to outweigh them. If physicists could resolve to adopt it, it would seem pretty sure of general and complete acceptance, and therefore offer one more piece of the difficult and contentious "No Man's Land" of conflicting units won over for the right side.

R. A. SAMPSON.

DEEP-SEA NEMERTINES.

DURING the forty years which have elapsed since the first two deep-sea nemertines were taken by the *Challenger* Expedition, a few examples have been collected by various other expeditions, but deep-sea nemertines have never been other than rare. Prof. Brinkmann, whose monograph on pelagic nemertines has recently been issued (Bergens Museums Skrifter, Bd. iii., No. 1, 1917, 194 pp., 16 plates), has, however, had a rich collection at his disposal, chiefly from the *Michael Sars* Expedition, so that he has been able to investigate the structure of most of the species described. He has also subjected the previously known species to careful revision, and concludes that five of them are so imperfectly described that they must be labelled as "uncertain." The rule that the single type specimen of a species should be kept intact is, in the opinion of the author, unsound, for the external features often give little help to the systematist, and therefore investigation by means of serial sections is indispensable.

The known pelagic nemertines, all of which belong to the order Hoplonemertini, are referred to eighteen genera and thirty-seven species. Bathynemertes is the most primitive genus, and in its external features resembles the bottom-living forms. Among the pelagic nemertines two types have been evolved:—(1) By an increase in the size of the gut diverticula, and therefore of the body surface—without a corresponding increase of tissue—some became specially adapted to a floating life, and in these a marked reduction of the musculature of the body-wall took place; (2) from the floating forms arose the swimmers, in which a tail-fin was formed, with strengthening of the parts of the musculature necessary for swimming. Two specimens of *Nectonemertes mirabilis* were observed swimming by means of undulations of the body and energetic strokes of the tail. These are the first recorded observations on the swimming of pelagic nemertines.

We have not space to give an adequate summary of the account of the structure of these animals, but reference may be made to the general reduction of sense-organs, to the presence of penes in Phallonemertes, to the reduction in the number of eggs to three or four in each ovary, or in the more modified genera to two, or even one, and to the presence of cephalic tentacles in Balænanemertes in both sexes, and in Nectonemertes in the male only, in which they probably act as claspers.

The author discusses the horizontal and vertical distribution of pelagic nemertines, some of which certainly, and the rest probably, are bathypelagic. Most of the species will probably be found to have a wide distribution, *e.g.* *Nectonemertes mirabilis* occurs in the tropical parts of the Atlantic and Pacific Oceans and in Davis Strait, the conditions as to temperature, etc., being uniform over a wide area in deep water. In spite of the enormous mass of water transported by the Gulf Stream into the North Sea, no example of any Atlantic species of pelagic nemertines has been taken in the North Sea. There is also a total absence of records from the Mediterranean, explicable by the fact that the pelagic nemertines in the Atlantic live in deep water, while the entrance to the Mediterranean at Gibraltar is comparatively shallow.

CATTLE-POISONING BY WATER DROPWORT.

We have received from Mr. C. B. Moffat, of Enniscorthy, a note written at the suggestion of Mr. R. J. Moss, registrar of the Royal Dublin Society, in which the question is asked, "Is *Oenanthe crocata* wholesome food?" The question is put owing to the fact that about a month ago Mr. Moffat had occasion to observe a herd of cows browsing on this plant, and had been able to satisfy himself that no injurious effects resulted. As he justly remarks, the records of death from eating this plant leave no doubt as to its usually poisonous character. He cites a case, investigated by Mr. Moss in 1917, in which roots of this plant were found among the stomachic contents of four cows found dead on land that had been flooded. He is, therefore, led to inquire whether the poison is confined to the roots or if at particular seasons or in particular localities the green parts of the water dropwort are innocuous. Cornevin ("Plantes Vénéneuses") has stated that this plant, on which animals readily browse, leads to cases of poisoning every year; that all parts of the plant are toxic, the root being particularly so; and that drying does not destroy the noxious principle. Holmes (*Pharm. Journ.*, 1902, p. 431) refers to *Oenanthe crocata* as perhaps the most dangerous and virulently poisonous of our native plants. Long ("Plants Poisonous to Live Stock," p. 37) has more recently cited a formidable number of specific English instances confirming the judgment of Cornevin and Holmes. Nevertheless, notwithstanding the silence of these distinguished authorities on the point, the question raised by Mr. Moffat is not new. So long ago as 1845 an authority so eminent as the late Sir Robert Christison ("Poisons," p. 860) explained that while this plant has usually been held to be one of the most virulent of European vegetables, and seems well entitled to this character in general, yet climate or some other more obscure cause renders it inert in some situations. As Christison pointed out, the plant has been the subject of an uninterrupted series of observations since 1570, when Lobel directed attention to its poisonous properties. These observations show that in France, Germany, Holland, Spain, and various parts of England so far north as Liverpool it is actively poisonous at all seasons of the year. Yet the careful experiments undertaken by Christison, while proving the virulence of the plant as grown near Woolwich and near Liverpool, showed that the same species as grown near Edinburgh is devoid of toxic properties. It is singular that little more is known now than Christison knew, and it is to be hoped that those competent to deal with the matter may be induced to undertake the research which is required to settle the questions raised by Mr. Moffat's confirmation from County Wexford of Sir Robert Christison's experience of three-quarters of a century ago as regards Midlothian.

AERONAUTICAL INVENTIONS.

The Air Ministry wishes it to be known that the Air Inventions Committee, which was formed about nine months ago, has now received and examined upwards of 5000 inventions and suggestions relating to the Air Service. It is regretted that, owing to war conditions, a detailed account of the investigations cannot be published, but the experience of the Committee indicates that it may be possible to publish certain information which will facilitate the work both of the inventors and of the Committee.

The following statement has been drawn up with this object in view, but it is realised that it is incomplete for the reason just given. It is appreciated also that inventors are placed at great disadvantages in present circumstances, for, unless immediately connected either with the Air Services or with aircraft manufacture, it is almost impossible that they should be acquainted with the most recent developments; so rapid has been the rate of progress that it is difficult, even for those in close contact with the Royal Air Force, to keep abreast of all the latest improvements. Again, it is practically useless for inventors at the present time to submit inventions which would necessarily take a long time to develop, the requirements of war and the conditions of labour and material making it impossible for the Committee to support proposals of this nature.

Generally speaking, and so far as the period of the war is concerned, no very startling change in the present type of aircraft is anticipated, although improvements in parts and also in details are always possible, and may produce very important results.

The stage of development in construction which has now been reached is such that major improvements can be expected only from those possessing the requisite scientific and mechanical knowledge, skill, and experience. Thus radical changes in the shape of the wings of aeroplanes, the body, and the propellers are possible only after long and patient research carried out in aeronautical laboratories.

Again, many inventors have forwarded proposals for helicopters and aircraft of this nature, which, if an efficient design can be produced, would possess certain advantages (but probably not so great as was once imagined); others have suggested flapping wings and rotatory planes. Such schemes do not give any promise of being developed for use during this war, and in any case would require some years of experiment before they could be regarded as practical proposals.

As regards minor improvements, inventors should bear in mind that many details, such as turnbuckles, clips, etc., are now standardised, and a change would be justified only by some very marked superiority.

Safety devices for preventing crashing of the machine and the pilot form a numerous class. The chief of these is the parachute, either applied by a harness to the pilot or directly attached to the machine. Those who have seen a passenger dropped by a parachute from an aeroplane for exhibition purposes often fail to realise the conditions under which a parachute may have to be used as a safety appliance. Then the machine may be out of control, dropping at a velocity of 150 to 200 miles per hour, or spinning downwards in flames. Many other safety devices, such as automatic stabilisers, wind-brakes, etc., have been proposed at various times. The additional weight entailed by the use of any of the suggested safety appliances must remain a very serious factor for so long as war conditions prevail.

The engine is the heart of the aeroplane, and on its trustworthiness depends the safety of the pilot. Persons acquainted only with motor-car engine practice sometimes do not realise the exacting conditions under which an aeroplane engine must work. The engine must be capable of running for the whole of the time of flight at its maximum power. The lubrication and ignition must be perfect, and the engine must not become overheated. The rating applied to aeroplane engines is the weight per horse-power, and engines are now being produced which show surprising results in this respect. Inventions which differ radically from present-day practice (such as the internal-combustion turbine) have small possibilities of being adopted, for successive design and reconstruction, entailing probably several years' work, are necessary before satisfactory results can be hoped for.

In view of the shortages of materials and labour at the present time, no new type can be embarked on unless it is demonstrably superior to existing types and possessed of definite and immediate advantages over them.

A subject which is intimately connected with the power plant is its noise. This constitutes one of the disadvantages of an aeroplane. For night-flying a method by which it would be possible to hear from one aeroplane the approach of another would be of great advantage. The engine can be silenced without serious disadvantages, but the noise of the propeller and the hum of the wires are so great that silencing the engine is not sufficient.

Many proposals for the projection of bombs and grenades of flame and of poisonous gases have been received. The trailing bomb or grapnel for attacking enemy aircraft and submarines is a favourite suggestion from inventors. This device was tested before the war and at various times since, but has been abandoned in favour of more effective methods.

Many hundreds of inventions and suggestions for inclinometers and instruments for straight flying and accurate bomb-dropping have been investigated. Efficient and well-designed instruments for these purposes have been available for some time past, but it is quite possible that improved forms may be produced, though it is scarcely likely that this can be done by anyone who does not possess the necessary scientific and mechanical knowledge required for an investigation of this nature. Some inventors entirely disregard the action of centrifugal force upon pendulum and spirit-level devices.

A large number of gyroscopic instruments have been proposed which show insufficient knowledge of the correct application and limitations of a gyroscope.

Anti-aircraft devices of various kinds are constantly suggested, but now contain very little new matter for consideration, as such proposals have received the careful attention of the authorities for a long time past, and have been the subject of much trial and experiment.

The Committee fully appreciates the genuinely patriotic motives which inspire most of the communications which they have received, and it is with the object of encouraging the submission of useful and well-considered proposals that this statement is issued. Inventors should, however, bear in mind that the somewhat obvious proposals which might have been useful in an earlier stage of the war are now no longer serviceable.

FOOD CONSERVATION BY REDUCTION OF RATIONS.[1]

It is perhaps remarkable that, with all the current discussion regarding food conservation, so little emphasis has been laid upon the possibility of conserving food by reducing the diet. When one recalls the agitation of enthusiasts for reduced diets during the past thirty years, and recognises the fact that all special pet theories can at this psychological moment obtain a better hearing than at any previous time, it is surprising that the advocates of reduced diet have made so little progress, and, indeed, have apparently ceased their propaganda.

The popular conception that we eat too much is usually quantitatively expressed by the statement that we eat "twice as much as we ought." The nutrition laboratory has for years been endeavouring to discover if there exist any special groups of individuals who live regularly upon a diet that would be commensurately low. For this purpose it was assumed that the minimum or basal metabolism must be taken as the index of food requirement. Differences in muscular activity are so great that no two individuals can be compared save on an absolutely quiescent, resting basis. After the metabolism of two hundred or more individuals had been carefully measured, it was seen that, although we were dealing with people of varying ages and dietetic habits, and of supposedly very low metabolism, no such individuals were easily recognised in our measurements. It would thus appear offhand that if there are no individuals other than pathological which present abnormally low basal metabolism, and if the law of conservation of energy in the human body obtains, as we know it does, then there is no *a priori* reason for expecting that a reduced diet can be permanently adhered to. A reduction in diet will simply mean that body reserves will be drawn upon until death from starvation occurs.

Through the kind offices of Profs. J. H. McCurdy and Elmer Berry, of the International Y.M.C.A. College at Springfield, Massachusetts, both unusually interested in metabolism problems, arrangements were made to select twelve men out of a group of volunteers from the student body. The men entered heartily into the spirit of the whole research, and readily consented to all the strict requirements of the test.

The general plan was to curtail the diet sufficiently to reduce the weight approximately 10 per cent. This could have been done by a complete withdrawal of food for about fourteen or fifteen days. It was recognised that these men were, first, college students with obligations for educational advancement, and, secondly, volunteers for scientific research. A complete fast for fourteen days would, in all probability, have caused most of them considerable discomfort, if not distress. The alternative was to curtail the dietetic intake so that the weight-loss would take place, not in fourteen days, but in four to six weeks. This was done by serving the men approximately one-half to two-thirds of the caloric requirements prior to the dietetic control, making absolutely no change in the kinds of foods eaten. The young men were cautioned not to lessen their mental or physical activities. Obviously if the activity of a group of men were lessened, as, for example, by putting them to bed, to use an extreme illustration, their dietetic requirements would be very much less. Suffice it to say that these men carried out all the requirements of collegiate activity, both physical and intellectual, throughout the entire period. As soon as the reduction in weight had reached 10 per cent. or thereabouts, the calories in the intake were increased to such an extent as to hold the weight at a constant level. The number of calories required to hold this weight constant over a considerable period of time could be taken as a fair representation of the actual caloric requirement for this group of men.

To ensure a suitable base-line, therefore, a second group of twelve men from the large number of volunteers originally presenting themselves was selected to act as a control squad. These men were in every particular studied with the same degree of care as squad No. 1, except that there was no dietetic control.

While body-weight can be taken as an approximate index of the metabolic level, further checks were absolutely necessary to rule out the inevitable differences in muscular activity that would be found with groups of individuals, even when they were subsisting under the same collegiate conditions. The gaseous metabolism was therefore measured practically every morning for each one of the first squad. These measurements were made by collecting the expired air and analysing it. From the amounts of oxygen con-

[1] Abridged from an address on "Physiological Effects of a Prolonged Reduction in Diet on Twenty-four Men," given to the American Philosophical Society on April 20 by Prof. Francis G. Benedict. (From the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Massachusetts.)

sumed and carbon dioxide produced, the basal heat output could be computed by indirect calorimetry, thus furnishing the second index of metabolic level. The pulse-rate was recorded simultaneously every morning. Every other Saturday night the entire group of men was taken to Boston and placed inside a large respiration chamber, where the men could sleep comfortably. The carbon dioxide excretion of the twelve men was thus determined simultaneously during deep sleep. This furnished a third criterion for judging the metabolic level.

The control squad showed no seasonal variation, and their basal metabolism, as measured in the large respiration chamber in Boston, was found to be absolutely identical with that of the first group of twelve men prior to the restriction in diet. To check the important findings with the first squad during the early period of the investigation, the second squad was later placed upon a very restricted diet for a period of three weeks, the diet given being less than one-half of their normal requirements.

For both squads, when on diet, the food for each day was carefully weighed, sampled, and analysed for the individual men. It is thus possible for us to measure the complete intake of protein and calories.

The most important scientific findings may be summed up as follows:—

(1) A gradual reduction in weight to a point 12 per cent. below the initial weight took place during a period of from three to ten weeks, with low calories and a moderate amount of protein in the food intake. The normal demand of the men prior to the dietetic alteration ranged from 3200 to 3600 net calories. One squad of twelve men subsisted for three weeks on 1400 net calories without special disturbance.

(2) After the loss in weight of 12 per cent. had been reached, the net calories required to maintain this weight averaged about 2300, or approximately one-third less than the original amount required.

(3) At the end of the reduction in weight the actual heat output during the hours of sleep, as computed by indirect calorimetry, was approximately one-fourth less than normal, thus giving a rough confirmation of the lowered number of calories found by actual measurement of the food intake. That there was no seasonal variation in metabolism was shown by the constancy in the metabolic level of the control squad.

(4) The heat output by indirect calorimetry per kilogram of body-weight and per square metre of body-surface was essentially 18 per cent. lower than at the beginning of the study.

(5) Throughout the period of loss in weight, and for some time afterwards, there was a marked loss of nitrogen to the body. In round numbers these men each lost approximately 150 grams of nitrogen. There is an intimate relationship between this "surplus nitrogen and the metabolic level. Removing the "surplus nitrogen," we believe, distinctly lowers the stimulus to cellular activity.

(6) The nitrogen output per day at the maintenance diet of 2300 net calories was about 9 grams. The control group of twelve men, living substantially the same life and eating in the same dining-room, but with unrestricted diet, showed a nitrogen output of 16 to 17 grams per day.

(7) The pulse-rate was astonishingly lowered. Many of the men showed morning pulse-rates as low as 33, and daily counts of 32, 31, and 30 were obtained; at least one subject gave six definite counts on one morning of 29.

(8) The blood-pressure, both systolic and diastolic, was distinctly lowered.

(9) The skin temperature, as measured on the surface of the hands and forehead, was with some subjects considerably lower than normal. With most of the men normal temperatures prevailed.

(10) The rectal temperature was practically normal.

My colleague, Dr. Walter R. Miles, found as a result of numerous tests of the neuro-muscular processes that there was no material change as a result of the reduced diet. There was a very slight falling-off in the strength tests with the hand dynamometer.

As one of the best indices of muscular performance, my associate, Dr. H. Monmouth Smith, measured the energy required by each man to walk one mile in about twenty minutes. With a reduced diet the requirement was found to be lower with all the men than with a normal diet, this being due, in part, to the fact that the reduced weight meant a lower weight to transport. In other words, these men walked a mile with noticeably less energy consumption than a man not subsisting on a reduced diet.

The subjective impressions were almost uniform that the muscles in the thigh were distinctly weakened. The men complained of difficulty in walking upstairs, but our personal observations go a long way towards refuting this, for all the men seemed able to go upstairs two steps at a jump on several occasions. On February 1, 1918, at Springfield, after four months on diet, eleven of the diet squad were pitted against eleven men from the college body in an arm-holding contest for endurance. The arms were held extended, palms down, at the level of the shoulder. The number of men falling out was practically the same in both squads; as a matter of fact, seven in the diet squad and eight in the uncontrolled squad held their arms out for one full hour.

The most noticeable discomfort experienced by the subjects was a feeling of cold, which it is only fair to say might be due in large part to the severity of the past winter. In general, notwithstanding the very great reduction in the metabolism, which we believe was due to the removal from the body of the stimulus to cellular activity of approximately 150 grams of "surplus nitrogen," the whole period of lowered food intake had no untoward effect upon the physical or mental activities, and the men were able to continue successfully their college duties.

When the second squad was put upon a restricted diet the picture exhibited by the first squad was strikingly duplicated in all details, although as the loss in weight was obviously not so great with the second squad (6 per cent. as compared with 12 per cent.) the phenomena were quantitatively somewhat less emphasised.

At the conclusion of the entire research the men presented an appearance not unlike the average college student; it would have been difficult to pick them out from the rest of the college body on the campus. On close inspection the members of the diet squad would perhaps have appeared somewhat emaciated, particularly in the face, but they were performing their duties as college students, both physically and intellectually, with no obvious reduction in stamina.

The great objection to making practical deductions from laboratory experiments is usually that such researches are carried out on the lower animals, or if men are studied, but one, or at the most two, are used. With a group of twenty-four men, such as was studied in this research, one is justified, if ever, in drawing deductions or making recommendations. We cannot then be charged with faddism or irrational propaganda if we are led to make certain definite recommendations—recommendations that admittedly we would never make in peace times, and that admittedly may have serious faults. These recommendations are primarily a war measure.

I find myself in a novel situation as a public advocate of far-reaching dietetic alterations. Recalling my earlier objections to Prof. Chittenden's inferences from his experiments, I realise that, although abstract science and propaganda are more or less incompatible, in time of stress old beliefs may well be challenged, earlier concepts discarded, and conservatism permitted to exercise a less restraining influence; hence a public avowal of change in point of view and an admission of the errors of earlier judgment are not only desirable, but also absolutely necessary. While still maintaining that the published records of Prof. Chittenden's experiments left the desirability of a propaganda for lower protein and energy open to serious fundamental criticism, I am now convinced that his data on protein intake justified many of his public statements and recommendations. His conjectures regarding calorie needs seem in no small part substantiated by the results of this new research.

Although some of our men were under twenty-one years of age, the data obtained in our experiments have no bearing on the period of growth; the diet of the growing child should in no circumstances be reduced. Neither are the results applicable to the conditions of severe muscular work, as, for example, in the Army. They may, however, legitimately suggest practices for patriotic civilians not performing severe muscular work; that these standards represent the optimum needs for peace times requires further evidence for substantiation. It is quite clear that a civilian body of men could readily withstand a siege on half-rations without difficulty for several months, and, since danger seems remote, that reduced rations for all adult civilians may be justifiable as a war measure for a relatively long period of months. Prof. Chittenden's conclusions from his experiments that a low protein diet is practicable seem fully substantiated; this expensive source of food material may thus be materially lowered. The calories may also, without doubt, be lowered. Indeed, it may become a serious question as to whether a patriot should be permitted in times of stress to carry excess body-weight, for the expense of carrying it around calls for calories that other people need. The excess weight is *prima facie* evidence that he is living at the highest metabolic level, higher than he needs by approximately 25 per cent., and there is no doubt that the excess weight contributes to shorten life.

It is quite clear that variation in diet is absolutely essential. If a person craves a certain article of food he may eat it, but he should stick religiously to the "half portion."

Of special significance is the importance of not eating between meals and of omitting the eating of extras. It has surprised us to find how large a proportion of the total diet is made up of these extras. Capt. Gephart, in his study of the food intake of St. Paul's School, Concord, New Hampshire, found that out of a total daily intake of 5000 calories per boy, 647 calories were derived from extras in the form of sweet chocolate, candy, coffee-buns, etc. With our control squad at Springfield, when on normal diet, approximately 4000 calories were consumed daily by each individual. Of this amount about 400 calories were obtained from extras not served at the table.

I cannot feel that an alteration in the Army diet is justifiable at present. It is bad policy "to swap horses in the middle of the stream." The fighting unit may well be exempted from innovations, but let the civilian population give this whole project a thorough, honest test, recognising that while there may be, in certain cases, an element of hazard, and in many cases an element of discomfort, the possibilities for danger in accomplishing a weight reduction of 10 per cent. are negligible. The calories thereby saved are by no means negligible, but with the sum-total of our population would feed an enormous Army.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LORD DURHAM has been elected Chancellor of Durham University in succession to the late Duke of Northumberland.

THE residue of the estate of the late Mr. T. P. Sims, of Swansea, has been left to the Swansea Technical School for the foundation of three two-year scholarships in the subjects respectively of chemistry, metallurgy, and modern languages for commercial purposes.

THE Board of Agriculture and Fisheries has awarded the Fream memorial prize for 1918 to Mr. Leonard C. Robinson, a student of the Harper Adams Agricultural College, Newport, Salop, who took the highest marks at this year's examination for the National diploma in agriculture.

WE have received a copy of the calendar of the Kyushu Imperial University. The University was established at Fukuoka by Imperial ordinance in December, 1910, the first article of which lays it down that "Imperial universities shall have for their objects the teaching of such arts and sciences as are required for the purpose of the State and the prosecution of original research in said arts and sciences." Among other interesting developments recorded in the calendar may be mentioned the establishment in 1914 of a marine biological station in connection with the institute of anatomy in the University. The regulations show that real efforts are being made to encourage research in the University; a certain number of students, who are possessed of high academic attainments and good character and wish to devote themselves to scientific research, are selected and appointed to research scholarships, exempting them from investigation fees, and providing a monthly allowance to enable them to pursue their study and research.

THERE was a discussion in Committee of the House of Commons on July 2 upon clause 22 of the Education Bill, which provides for the abolition of fees in all public elementary schools. Mr. Fisher, President of the Board of Education, replying to the arguments put forward in favour of the continued recognition of fee-paying elementary schools now existing, pointed out that the Bill retains fees in secondary schools and abolishes them in elementary schools, and provides for free education in continuation schools. In other words, it applies the principle that where education is compulsory it is to be given without charge to the parents, but where the parent has an option whether or not to send his child to a particular type of school there he should be at liberty to pay fees. It is the opinion of the inspectors of the Board that the existence of fee-paying schools militates against the proper organisation of higher-grade education in an area. The case for fee-paying schools is the provision of exceptional opportunities, but if the opportunities are no longer exceptional, the special case for those schools is greatly weakened. The clause was eventually agreed to without amendment, as were also the remaining clauses of the Bill.

Science for May 10 publishes a report of the Mellon Institute in the University of Pittsburgh, in which Prof. Kennedy Duncan's scheme for industrial research fellowships is in operation. Particulars of this scheme were published by the Board of Education some time ago in a pamphlet written by Mr. T. Ll. Humberstone. The progress made by the institute is indicated by the increase in the number of fellows from twenty-four in 1911–12 to sixty-four in 1917–18, the amounts contributed by the subsidising firms having increased in the same period from 39,700 dollars to

172,000 dollars. The subjects of research, a list of which is given in *Science*, indicate a wide range both in inorganic and organic chemistry. Dr. Raymond F. Bacon, who succeeded the late Prof. Duncan as director, has been commissioned in the American Army in command of the Chemical Service Section. A considerable number of the research fellows are working on war problems assigned to the institute by the National Research Committee, and others have entered military service. The shortage of research men of the type demanded by the fellowship system has forced the institute to hold in abeyance a number of desirable research problems. "It required the cataclysm of the great war,' the report observes, "to bring men to realise fully the part which applied science is playing, and, more particularly, will play, in the life of nations"; and the Mellon Institute is proud that it has been a pioneer in this field, and set an example to other institutions. The report is signed by Dr. E. R. Weidlein, the acting director.

The Education (Scotland) Bill was read a second time in the House of Commons on June 26. The Bill is divided into two parts—administrative and educational. The educational area will be the county. The authority will be what is commonly known as an *ad hoc* authority, or an authority specially elected for the purposes of education. The members of the authority will be all directly elected. As the simple majority vote does not afford reasonable protection to existing minorities, or give them the opportunity of making their voices heard in the councils of the community, it has been decided to introduce the principle of proportional representation. The main object of the Bill is the better education of the whole of the people of Scotland, irrespective of social class, age, sex, or place of residence. The effect of the two main proposals of the measure is that when the Act comes into full operation the education of practically every young person will be continued, in one form or another, until he or she reaches the age of eighteen. There is also ample provision to prevent the exploitation of child-labour by parents or employers. It is not proposed at first to raise the age for compulsory attendance at continuation schools beyond sixteen. But power is taken in the Bill to raise the age further by instalments to seventeen and eighteen as circumstances permit. It is proposed to make a special grant in aid towards the local expenditure of those authorities who in the discharge of a national duty find themselves obliged to impose upon their constituents a burden higher than that which is the average in the country.

The Library Association (Caxton Hall, Westminster) has issued a "Class List of Current Serial Digests and Indexes of the Literature of Science, Technology, and Commerce," published as Appendix A to the final report of the Library Association Technical and Commercial Libraries Committee. The list is intended to show the minimum bibliographical equipment of a library professing to specialise in certain departments of knowledge, and is issued for the guidance of librarians. For example, we are told that a library that specialises in chemistry should include the abstracts published by the American Chemical Society and by the Chemical Society of London. Similar information is given with regard to some fifty other subjects in pure and applied science, manufactures, law, and economics. In making their recommendations as to the choice of publications containing abstracts of the literature of the different subjects considered, the compilers of this list have ignored German serial digests except when no suitable substitute in another language could be found. It is not explained why this course is taken, but probably it is thought that libraries should not be encouraged to buy German books at the present time, even if they are able to do so. At all events, the list will direct special attention to English and American bibliographies and abstracts, which may be used instead of the German publications, to which, perhaps, in the past undue preference has been given. In recommending this list to all who are interested in the formation and maintenance of libraries, we would lay stress on the statement that it represents a minimum equipment of periodical works of reference. There are, of course, many similar works, not included in the list, that a good library should possess.

In the *Revue Scientifique* for April 20–27 M. Paul Otlet has an article on "Transformations opérées dans l'appareil bibliographique des sciences—Répertoire, Classification, Office de Documentation." By the term "répertoire" or "repertory" he means a card catalogue or a loose-leaf catalogue in which new matter can be quickly inserted in its proper place without disturbing any other part of the catalogue. M. Otlet urges that all catalogues of books and papers should be arranged in this way. As to the details of classification, M. Otlet is, as is well known, a strong advocate of the decimal system. As this system is by no means generally understood, we may quote an example given in this article The number 31 stands for *statistics*, 331.2 for *salaries*, (44) for *France*, "17" for the *seventeenth century*. The full expression 31 : 331.2 (44) "17" means: "Statistics of salaries in France in the seventeenth century." But these four numbers may be rearranged on the index-card in all possible permutations. For example, (44) 31 : 331.2 "17" would be translated: "France: statistics of salaries in the seventeenth century"; while "17" (44) 31 : 331.2 would mean: "The seventeenth century in France, statistics of salaries." It is to be observed that the colon, brackets, and quotation marks are integral parts of the decimal system as used by M. Otlet. In the third section of M. Otlet's article it is explained that an office of documentation is a library in which all books, and even parts of books, have been indexed on cards in accordance with the decimal system of classification. It is claimed that anyone possessing the key to the classification will then be able in a few minutes to obtain a list of all the books in the library bearing on a particular subject in which he may be interested.

SOCIETIES AND ACADEMIES.

London.

Zoological Society, June 11.—Mr. A. Ezra, vice-president, in the chair.—Lt.-Col. S. Monckton **Copeman**: Observations on a colony of burrowing bees (*Andrena fulva*).—Dr. A. Smith **Woodward**: Two new Elasmobranch fishes from the Upper Jurassic lithographic stone of Bavaria.—Morley **Roberts**: The function of pathological states in evolution.

Mineralogical Society, June 18.—Mr. W. Barlow, president, in the chair.—W. A. **Richardson**: The origin of septarian nodules. Septarian structure consists not of a simple combination of radial and concentric circles, but of irregular polygons closely simulating mud-cracking. By experiments with clay balls and films, and comparison with timber cracks, it was shown that radial cracks widening inwards are produced by internal circumferential contraction, radial cracks widening outwards by internal expansion, concentric cracks by contraction towards the centre, and polygonal cracks by either free or chemical desiccation. Moreover, analysis shows that septarian nodules are more aluminous towards the centre than the outside, and are therefore capable of contraction. The evidence disproved the expansion theories, and showed that contraction on numerous centres in a colloidal medium caused the cracking, and desiccation by chemical agents the contraction. The central portions are not merely enclosed clay, but clay that has undergone considerable chemical modification, and the original colloidal nature of the medium is so changed that closing of the cracks by absorption when placed in water cannot occur. Finally, the occurrence of the nodules suggests their origination by rhythmic precipitation according to the laws of Liesegang from solutions of bicarbonates diffusing through a colloidal medium.—Dr. C. T. **Prior**: The composition of the nickeliferous iron of the meteorites of Powder Mill Creek, Lodran, and Holbrook. A simple and expeditious method of determining the amount and chemical composition of the nickeliferous iron of a meteorite was described. The method depends upon the use of dimethyl glyoxime for the separation of nickel. Its application to the meteorites Powder Mill Creek, Lodran, and Holbrook gave percentages respectively of about 42, 30, and 6½ of nickeliferous iron, in which the corresponding ratios of iron to nickel were about 13, 11½, and 5.

Royal Meteorological Society, June 19.—Sir Napier Shaw, president, in the chair.—Dr. S. **Chapman**: The lunar atmospheric tide at Greenwich, 1854–1917. The tidal forces due to the moon affect the aerial as well as the fluid ocean, and the lunar atmospheric tide is manifested by the periodic variation in the height of the barometer having two maxima and two minima (high and low tide) in the course of a lunar day. This variation is much smaller than the solar semi-diurnal barometric variation, which is not a simple solar tidal effect; the minute lunar variation, however, can be detected with ease in the records of tropical observatories, where the irregular fluctuations of pressure are small. Attempts to determine it in the records of European observatories have been made, but hitherto without success. By treating hourly observations of "quiet" days only, on which the barometric range did not exceed 0·1 in., and by abstracting the solar variation, the lunar atmospheric tide at Greenwich has now been ascertained. Its total amplitude is less than 0·001 in., the harmonic formula being $0{\cdot}00036 \sin(2t+114^\circ)$ in., where t represents lunar time measured, at the rate of 360° per lunar day, from the epoch of upper transit. A comparison with the variation at Batavia (lat. 6° S.), viz. $0{\cdot}00256 \sin(2t+65^\circ)$ in., suggests that the amplitude varies as the fourth power of the cosine of latitude, and that the phase also varies with latitude.—Miller **Christy**: The audibility of the gunfire on the Continent at Chignal St. James, near Chelmsford, during 1917. In this paper the author continues his series of observations of the sound of gunfire commenced in 1915, and published by the society in 1916. Mr. Christy considers that the most interesting point in connection with his observations is the fact that there is apparently (1) a regular and well-defined season or period during which the gunfire is usually audible with ease, and that this is followed by (2) a longer season or period during which the gunfire is seldom or never heard. The following are the earliest and latest dates of the sound of the gunfire on the Continent as heard at Chignal St. James during the three years 1915–17:—1915: From about May 1 to about August 31 = 17 weeks 3 days. 1916: From about May 1 to about August 15 = 15 weeks 1 day. 1917: From about April 22 to about September 6 = 19 weeks 4 days.—F. J. W. **Whipple**: Seasonal variation in the audibility of gunfire. Mr. Miller Christy's observations indicate that in Essex Continental gunfire is heard only during the summer months. On the other hand, evidence collected by W. Brand, and published in the *Meteorologische Zeitschrift* in February, 1917, indicates that in Germany at places 100 km. or more from the firing-line such sounds are heard only during the winter. Thus it appears that in summer the outer zone of audibility lies to the west of the source of sound, in winter to the east. No theory hitherto put forward in explanation of the existence of the outer zone of audibility is in accord with this generalisation.

Royal Microscopical Society, June 19.—Mr. J. E. Barnard, president, in the chair.—Prof. Benjamin **Moore**: Studies of activity of light in inorganic and organic systems. The chief points dealt with were (1) the natural modes of production of reduced organic compounds with uptake of energy, (2) the synthesis of formaldehyde from carbon dioxide and water by the action of light, (3) condensation of formaldehyde in light to form reducing substances such as sugars, (4) reduction of nitrates by sunlight, accompanied by energy absorption, (5) growths of organisms in nitrate and nitrite-free media in presence and absence of air, showing that nitrites in air are essential, and that nitrogen fixation in soil is probably due to nitrite fixation from the atmosphere.—Dr. E. **Penard**; A new type of Infusorian, *Arachnidiopsis paradoxa*. The organism described, egg-shaped and about 1/500 in. in length, has neither cilia nor setæ, but its locomotive organs consist of two flexible tentacula, which beat the water with great rapidity. The forms described under the genus Arachnidium by Saville Kent were possibly of the same type.

Linnean Society, June 20.—Sir David Prain, president, in the chair.—Prof. H. **Coutière**: Les espèces d'Alpheidæ rapportées de l'océan indien par M. J. Stanley Gardiner.—Sir N. **Yermoloff**: A series of intermediate forms of the Diatom genera Navicula and Cymbella. An examination of the series suggests the hypothesis that the large, simple, and homogeneous ancestral form *Navicula monmouthiana* was a primordial species adapted to the more uniform conditions of life on the planet during the pre-Glacial epochs, and that the Cymbellæ which afterwards evolved from it are smaller, more complex heterogeneous forms, gradually derived from *Navicula monmouthiana* under the influence of quite different and more varied conditions of life and climate, which established themselves on the earth after the Glacial epochs, at least under the latitudes between 40° and 60° N. A similar trend of changes from larger and less varied forms to smaller heterogeneous ones has affected the whole of organic life after the Glacial extensions towards the south.—E. J. **Collins**: Sex-segregation in the Bryophyta. Three cultures of *Funaria hygrometrica* were made in Marchals's nutrient fluid as follows:—A, protonemata grown from the antheridia of a male "flower"; B, protonemata grown from the perigonial leaves of the same male "flower"; C, spores from a ripened capsule. Submitted to the same cultural conditions, A and B produced a sward of plants with large discoid male "flowers" *only*, no sporogonia being produced at any time; C produced plants bearing male and female organs, resulting in a dense crop of sporogonia. It appears possible that vegetative development from structures borne on male and female branches respectively may, if a sex-segregation has actually occurred somatically, lead to the production of distinct male and female plants.

DUBLIN.

Royal Irish Academy, June 10.—Prof. G. H. Carpenter, vice-president, in the chair.—T. A. **Stephenson**: Certain Actiniaria collected in Irish waters during the years 1899–1914. The paper dealt with part of the collections of sea-anemones made by the scientific staff of the Irish Fisheries Branch. Twenty-one species are enumerated, mostly from deep water off the west coast of Ireland. Of these seven have not previously been described, viz. *Actinostola atrostoma, Cymbactis gossei, Actinernus aurelia, Chondractis coccinea, C. pulchra, C. duplicata*, and *Carlgrenia desiderata*. The last species is the type of a very interesting new genus, related to Halcurias, McMurrich.

PARIS.

Academy of Sciences, June 17.—M. Léon Guignard in the chair.—J. **Boussinesq**: Uniformity of flow in hour-glasses. The amount passed appears to be independent of the height of the sand.—G. Neumann was elected a correspondant for the section of rural economy in succession to the late M. Heckel, and A. Lameere a correspondant for the section of anatomy and zoology in succession to the late Prof. Yung.—H. **Villat**: Certain singular Fredholm equations of the first species.—P. E. B. **Jourdain**: Demonstration of a theorem of ensembles.—E. **Cahen**: The series of Dirichlet.—M. **Poincet**: Theoretical and experimental study of steam turbines.—C. **Flammarion**: Observations of the new star in Aquila.—M. **Luizet**: First observations of the new star. The nova was seen on June 8 at 8.41 G.M.T. Measures of magnitude are given to June 14.—R. **Griveau**: The heat of formation of the anhydrous calcium borates.—A. **Mailhe**: The direct transformation of the secondary and tertiary amines into nitriles. In a preceding communication it has been shown that it is possible to transform di-isoamylamine and tri-isoamylamine into isoamyl nitrile by passing the vapours over finely divided nickel at 350° to 380° C. The generality of the method is now proved by the preparation of the corresponding nitriles from dicaproylamine, tricaproylamine, diamylamine, triamylamine, bibutylamine, tributylamine, dipropylamine, and tripropylamine. The general reaction is

$$(C_nH_{2n+1})_2NH = 2H_2 + C_nH_{2n} + C_nH_{2n-1}N.$$

J. **Martinet**: The isatines which contain a quinoline nucleus.—M. **François**: A method for the estimation of the halogens, sulphur, and nitrogen in presence of mercury. The mercury is removed as metal by the action of zinc, and the above-mentioned elements are then determined in the usual manner.—L. **Gentil**: The existence of large "nappes de recouvrement" in the province of Cadiz, Spain.—H. **Coupin**: The harmful action of magnesium carbonate on plants. The harmful action of magnesium carbonate was proved for eight species of plants.—F. **Maignon**: Comparative study of the toxicity and nutritive power of food proteins employed in a pure state. Experiments on white rats with diets of either white of egg, fibrin, casein, or meat-powder. For the three last foods the cause of death was exhaustion of the reserves, and not chronic intoxication. The toxic action of albumen has been described in an earlier paper.

BOOKS RECEIVED.

The Action of Muscles, including Muscle Rest and Muscle Re-education. By Dr. W. C. Mackenzie. Pp. xvi+267. (London: H. K. Lewis and Co., Ltd.)

Peru-Bolivia Boundary Commission, 1911–13. Reports of the British Officers of the Peruvian Commission, Diplomatic Memoranda, and Maps of the Boundary Zone. Edited for the Government of Peru by the Royal Geographical Society of London. Pp. xi+242. (London: Cambridge University Press: Printers.)

British Museum (Natural History). A Map showing the known Distribution in England and Wales of the Anopheline Mosquitoes, with Explanatory Text and Notes. By W. D. Lang. Pp. 63. (London: British Museum (Natural History), and others.) 2s. 6d.

The Statesman's Year-Book, 1918. Edited by Sir J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xlviii+1488. (London: Macmillan and Co., Ltd.) 18s. net.

Memoir of John Michell, M.A., B.D., F.R.S. By Sir A. Geikie. Pp. 108. (Cambridge: At the University Press.)

DIARY OF SOCIETIES.

FRIDAY, JULY 5.

ARISTOTELIAN SOCIETY, at 9.—Space—Time: Prof. S. Alexander.

SATURDAY, JULY 6.

ARISTOTELIAN SOCIETY, at 10 a.m.—*Symposium*: Are Physical, Biological, and Psychological Categories Irreducible? Dr. J. S. Haldane, Prof. D'Arcy W. Thompson, Dr. P. Chalmers Mitchell, and Prof. L. T. Hobhouse.—At 2.30.—*Symposium*: Why is the "Unconscious" Unconscious? Dr. E. Jones, Dr. W. H. R. Rivers, and Dr. M. Nicoll.

SUNDAY, JULY 7.

ARISTOTELIAN SOCIETY, at 2.30.—*Symposium*: Do Finite Individuals Possess a Substantive or an Adjectival Mode of Being? Dr. B. Bosanquet, Prof. A. S. Pringle-Pattison, Prof. G. F. Stout, and Lord Haldane.

MONDAY, JULY 8.

ARISTOTELIAN SOCIETY, at 2.30—Special Problems.—At 8.—The Philosophy of Proclus: Prof. A. E. Taylor.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, JULY 11, 1918.

SIR WILLIAM RAMSAY.

Sir William Ramsay, K.C.B., F.R.S. Memorials of his Life and Work. By Sir W. A. Tilden. Pp. xvi+311. (London: Macmillan and Co., Ltd., 1918.) Price 10s. net.

IT has been said that every man has in his own history the making of at least one romance. If by romance is implied not merely a work of fiction, but also a story which is both true and marvellous, this may certainly be asserted of the life-histories of many men of science. A score of illustrations might be cited, if necessary, in proof of it. But it needs no proof to those who are in the least degree familiar with the personal history of science. The life-story of the subject of this memoir, as developed by Sir William Tilden, is further evidence of it. His biography of his eminent friend is one more addition to the already extensive literature of the romance of science.

Ramsay's relation to his epoch and his position in the chronicles of science are established for all time by his share in the discovery of the inert gases of the atmosphere, and by his recognition of helium as a terrestrial element. Most discoveries are based, in greater or less degree, upon antecedent knowledge, and the discoveries upon which Ramsay's fame chiefly rests are no exception to this general rule. Their wonderful succession may be said to take rise from Lord Rayleigh's memorable letter of September 29, 1892, in these columns, in which he first directed public attention to the difference in density between atmospheric and factitious nitrogen, and invited chemists to offer suggestions as to the cause. Ramsay's alert mind was soon at work on the mystery. How he came to associate himself with Lord Rayleigh in attempting to solve it, and how, by independent steps, the two investigators succeeded in completely elucidating it, constitute not the least interesting, and certainly the most historically valuable, chapter in Sir William Tilden's book. Although nearly a quarter of a century has elapsed since the British Association meeting at Oxford at which the epoch-making announcement of the discovery of argon was made, to be followed, a few months later, by the remarkable gathering in the theatre of the University of London in Burlington Gardens, at which a detailed account of the investigation was presented to the Royal Society, the memory of it all is still fresh to those now living who were fortunate enough to be present on those historic occasions. The story is again told in this book, simply and directly, and to a great extent by excerpts from Ramsay's correspondence with his wife and with his co-worker. Indeed, it tells itself by its intrinsic interest and power, and the author, like a true artist, shows a wise restraint in not over-elaborating it.

The formal announcement of the isolation of argon was followed, with an almost dramatic quickness, by Ramsay's detection of helium among the gases which Hillebrand had found to be evolved from the mineral cleveite, and to which Ramsay's attention had been directed by Sir Henry Miers, at that time keeper of the Mineral Department of the British Museum. The identity of the new gas with the solar helium of Lockyer, who first discovered it spectroscopically, was established by Sir William Crookes, to whom Ramsay had sent a sample of the gas.

In June, 1898, Ramsay and Travers announced the existence of krypton in the least volatile portions of liquid air, and a fortnight later they detected the presence of another new gas, neon, followed some little time afterwards by the recognition of a third hitherto unknown substance, xenon—all of them companions of argon and resembling it in chemical inertness. They are, indeed, as an American chemist wittily termed them, the "tramps" among the chemical elements—"useless things which never did an honest day's work in their lives." An examination of the lighter portions and of the residues obtained from the less volatile fractions of about 120 tons of liquid air revealed no other new constituent of the atmosphere.

It is the detection, in such rapid succession, of these extraordinary substances which constitutes the element of romance in Ramsay's career. The gases are not only remarkable in themselves: they open up an entirely new and wholly unlooked-for development in the philosophy of chemistry. Although a score of years have passed since their existence was made known, the mystery of their origin, past history, and functions still remains one of the unsolved riddles of the universe. This epoch-making work was all compressed within less than half a dozen strenuous years. There has been nothing like it in the history of science since Davy's time, now more than a century ago.

On Ramsay's earlier and subsequent scientific work—mainly in inorganic and physical chemistry, for the most part done in collaboration with his demonstrators and students, to whom, like the born leader he was, he sought to impart some of his own unselfish and eager enthusiasm for investigation—there is the less necessity to dilate since it is all admirably summarised in the book under review.

In the space that remains we may indicate some of Ramsay's more obvious personal attributes. He was certainly a very complex character, and probably few outside the family circle could justly claim to know him thoroughly. Not that he was in the least degree unapproachable or retiring. On the contrary, a man of many social gifts and accomplishments, he was invariably at ease and happy in the society of his fellows and capable of strong and enduring friendships, as his biographer abundantly proves from the many letters which have been placed at his disposal. He was, moreover, an excellent conversationalist, with more of the saving grace of humour than we envious Southrons commonly attribute to the generality of his countrymen. An admirable *raconteur*, he had almost as big a fund of good stories as his name-sake the Dean. He shared with his friend Fitzgerald an Irishman's love of the whimsical and his fondness for paradox. Imagination is an excellent quality in a man of science, but it needs to be disciplined, and it must be admitted that Ramsay's, like the Laird of Dumbiedike's "will-yard powny," occasionally ran away with him. But men of his temperament are to be judged not so much by what they say as by what they print, and although there are, no doubt, occasional lapses, there is but little in Ramsay's published scientific work that will not stand the test of time.

It is perhaps useless to speculate on the influences which led Ramsay to adopt a career in science. He himself was inclined to attribute his calling to heredity; many of his forbears for generations on his father's side had been dyers, whilst on his mother's side they were physicians. It must have needed some strong predisposing cause of this kind, as there was little or nothing in the circumstances of his school or college life to determine it. The teaching of chemistry was on a low plane in Glasgow in those days, and mainly as part of the medical curriculum. The University as a school of research lived on the traditions created by Thomas Thomson. Ramsay received little regular instruction in theoretical chemistry in his youth, but he learned to use his fingers in Mr. Tatlock's laboratory. It was only when he went to Tübingen to study under Fittig that he gained some insight into systematic chemistry. Not that Fittig was a particularly inspiring teacher. At all events he seems to have exercised no permanent influence on Ramsay, for the dissertation on toluic and nitrotoluic acids which he presented for his degree is one of his very few papers on organic chemistry.

Nor was he more fortunate in his first appointment as assistant in the newly created department of chemical technology in Anderson's College, where he had few opportunities for research and none for being generally useful. On his removal to the university, as a demonstrator under the late Prof. Ferguson, he had more scope, and availing himself of a collection of Anderson's preparations of bone-oil products, he attacked the chemistry of the pyridine series.

As in the case of other chemists who, in the past, have risen to eminence, it thus happened that Ramsay was largely self-taught. What he became was due almost wholly to his own exertions. The habit of self-reliance thus engendered served to strengthen his independent character and to develop his mental vigour. That with such a training he should have reached the position in the world of science to which he ultimately attained is perhaps the strongest testimony that could be adduced to his innate power and capacity.

On his appointment to University College, Bristol, and especially after his election to the principalship, Ramsay began to take an active part in the educational movements of the time, and he was concerned, with others, in securing some measure of State aid for the poorly endowed and struggling provincial colleges. He held very strong views on university policy and on its relations to original inquiry, and his contempt for the examination system, which a certain section of the governing body in the University of London seems to worship like a fetish, became at length almost an obsession, and occasionally brought him into collision with colleagues who, whatever their private opinions might be, felt themselves bound in loyalty to make the best of a system which had been deliberately sanctioned by those who were ultimately responsible.

Sir William Tilden, with the aid of Lady Ramsay and of many friends, to whom he makes graceful acknowledgment, has put together an eminently readable book, in which he has handled his material with tact and discretion. He has evidently been in thorough sympathy with his subject, and has thus succeeded in presenting a particularly pleasing pen-portrait of his friend, for which those who knew and admired Ramsay will be grateful to him. We trace in his book the lineaments of one who has shed lustre on British science, whose happy life was rich in achievements which will hand down his name to remotest time, who was wholly unspoiled by success, but continued to the end to be the same generous, active-minded man which those who knew him best knew him to be.

T. E. THORPE.

ARTIFICIAL SEASONING OF WOOD.

The Kiln-drying of Lumber. A Practical and Theoretical Treatise. By H. D. Tiemann. Pp. ix + 316. (Philadelphia and London: J. B. Lippincott Co., 1917.) Price 18*s*. net.

THE true technique of the artificial seasoning of timber will depend upon a number of factors, as yet unknown, concerning the rate of passage of water in the walls of the constituents in different directions and under various conditions of dryness, also concerning the influence of stresses and rate of drying upon the shrinkage of the constituents and the wood itself. Our knowledge of these fundamental facts is, however, in an embryonic stage, and up to the present only certain elementary facts bearing on these problems have been discovered and partially elucidated. To their discovery Mr. Tiemann has contributed by years of research.

In the work under review, by reference to modern practice in kiln-drying and by discussions of the defects induced by inappropriate methods, conclusions are drawn as to the immediate causes of such defects as case-hardening (in which the external wood, shrinking under tension exerted by the internal wood, acquires a permanent set), lack of strength, brittleness, longitudinal furrowing and collapse, and splits induced by differential shrinkage or "explosion." These phenomena at the same time serve as means of partially gauging the efficiency of the precise treatment adopted. The differences in the treatments to be adopted in connection with various kinds of timber are in some cases correlated with marked structural features, as in the case of the oak, but in other cases are associated with no such anatomical peculiarities —*e.g. Taxodium distichum*—which opposes great resistance to rapid depletion of water. The result of our ignorance of the basic principles in play is that the modern technique of artificial seasoning is partly empirical.

Timber-drying kilns in which the necessary regulation of the temperature, relative humidity, and movements of the air can be secured belong to two main types.

One type is the tunnel-like "progressive" kiln, in which the timber enters at the moist end and leaves at the drier exit end, so that it encounters different conditions of temperature and moisture as it is moved along the tunnel. The other main type is the "compartment" or "chamber" kiln, in which the timber is stationary, but the conditions are periodically changed. By the use of such kilns, and with the aid of wet-bulb and dry-bulb thermometers and humidity charts, it is possible to discover and standardise methods of rapid seasoning that sufficiently conserve the desired properties of the timber treated, and also to vary the methods in accordance with the use to which the wood will finally be put. Mr. Tiemann gives a general account of various kilns belonging to these main types, but devotes most of his attention to the water-spray kiln with which his own name is associated.

Mr. Tiemann's book is a happy combination of the technico-scientific with the practical. For instance, in dealing with the most economic method of supplying the minimum amount of heat, a scientific discussion of the quantity of heat required is accompanied by practical information as to the methods to be adopted of obtaining, distributing, and conserving the heat required. Accordingly, instructions are given as to the architecture of the kiln, the laying out of several kilns in juxtaposition, the use of exhaust and "live" and superheated steam, the distribution and dimensions of the heating pipes, the aerating devices, and the nature, structure, and thickness of doors, walls, and roof.

In conclusion, this work may be recommended not only as the sole authoritative book of its kind, but also as summarising the author's extensive original scientific and practical investigations on the subject.

P. G.

TWO CATALOGUES OF SCIENTIFIC PUBLICATIONS.

(1) *University of Chicago. Publications of the Members of the University.* 1902–1916. Pp. x+518. (Chicago: University of Chicago Press; London: Cambridge Univ. Press, n.d.)

(2) *The "Athenaeum" Subject Index to Periodicals,* 1916. *Science and Technology, including Hygiene and Sport.* Pp. 162. (London: The *Athenaeum,* 1918.) Price 10*s.* net.

DURING the last twenty years there has been an extraordinary increase in the annual output of books and papers on scientific subjects. In the olden time many a quiet student would be content to spend his life upon one piece of work, producing at last one *opus magnum* in the hope that it might remain a permanent addition to human knowledge.

Now that schools, colleges, and universities have spread a knowledge of science abroad among the people, our men of science are no longer allowed to confine their publications to a record of their own researches, but are called upon to write text-books, articles in popular magazines, reviews, lectures, and addresses given at institutions, congresses, and receptions.

Knowing that all this scientific literature exists, anyone wishing to learn the present state of our knowledge on any given subject or of the theoretical views generally held upon it might well despair of ever discovering all that has recently been written on these subjects, if he could not rely upon the labours of bibliographers and compilers of indexes and catalogues to aid him in his search.

(1) A complete catalogue of all scientific publications throughout the world would be, unfortunately, very bulky. Some idea of its size may be gathered from an examination of the Catalogue of "Publications of the Members of the University, 1902–1916, published by the University of Chicago, compiled on the twenty-fifth anniversary of the foundation of the University." This catalogue is very inclusive, giving the titles of all books, articles, reviews, and theses published by members of the Chicago University during these fourteen years. The catalogue runs to 500 pages, and is remarkable as showing how prolific in published work a single university may be.

It is scarcely possible or even desirable to index the world's scientific literature on this scale, so that in any comprehensive catalogue some means must be found by which papers of minor importance may be eliminated.

No doubt a counsel of perfection would be that competent critics should read everything that is published and decide in regard to each book, pamphlet, or article whether it brought to light any new facts or fresh theories. Upon this decision the inclusion of the book or paper among those to be indexed would depend.

This is the method attempted by the International Catalogue of Scientific Literature. It must be confessed that the result depends very largely upon the judgment of the experts engaged upon the work.

(2) An alternative method is to draw up a list of journals of acknowledged character and to confine the catalogue to papers published in these journals. When this plan is adopted it is hoped that authors, finding that certain periodicals are always indexed by bibliographers, will gradually acquire the habit of sending any original paper they wish to publish to one of these periodicals. For the success of this plan it is necessary to publish a list of the periodicals indexed. Unfortunately, in the *Athenaeum* subject index of periodicals the high cost of composition and paper

has compelled the publishers to omit, for the present, the list of periodicals cited. In the section "Science and Technology, including Hygiene and Sport," published in April as part of the *Athenaeum* subject index for 1916, we are told that 311 periodicals are cited. The editors state that more than 500 periodicals have been indexed in their class lists for 1915–16.

The section "Science and Technology" of the "*Athenaeum* Subject Index to Periodicals" should have a wide circulation at the present time, when a knowledge of the best and most economical methods of carrying out a great variety of technical processes is of such importance to the country. The Council of the Library Association is to be congratulated on having brought this index into existence, and it is to be hoped that it will receive such support as will enable the work to be continued.

OUR BOOKSHELF.

Essentials of Practical Geography. By B. C. Wallis. Pp. xv+213. (London: Macmillan and Co., Ltd., 1918.) Price 4*s.* 6*d.* net.

THIS volume, which contains a great deal of original research work, is a valuable contribution to the practical side of the science of geography. It furnishes the teacher of the subject with a representative collection of practical exercises on the essential principles usually included in a four years' course of geography in an average secondary school. The 104 pages of part i. contain what may be regarded as a minimum course of practical geography. Part ii. (50 pages) is devoted to supplementary exercises which may be worked in the geography lessons or in the periods assigned to arithmetic, mathematics, physics, handwork, and drawing. The remainder of the book deals with outdoor work and advanced map-reading, revision exercises, etc. The work is skilfully planned, there being varied exercises for the beginner as well as for the advanced student. The principle of contour lines leads to isotherms, isobars, isohyets, etc. The diagrams showing isopleths for Java and Kew are particularly instructive.

The treatment of raininess is very full, several of the author's sets of monthly raininess maps being reproduced from the *Scottish Geographical Magazine* and from the *Monthly Weather Review* of the United States Weather Bureau. The example on p. 142 shows clearly the method of obtaining the "raininess numbers"; but since the actual monthly rainfall of Algiers for each month is given correct only *to the nearest inch,* it seems scarcely logical to calculate the theoretically evenly distributed rainfall in inches to two decimal places and to infer from the numbers so obtained that February is the rainiest of four months, each of which is credited with 4 in. of rain. If the figures for the monthly rainfall of Bombay had been given to a closer degree of accuracy, the corresponding raininess numbers given on p. 143 could have been made to agree with those assigned to Bombay on p. 43. On p. 143 (sixth line from the bottom) the word "quarter" should be "third."

At the end of the book is a useful glossary, a collection of examples of subjects for debates, and a set of indexes. W. M. C.

Practical Organic and Bio-chemistry. By R. H. A. Plimmer. New and revised edition. Pp. x+636. (London: Longmans, Green, and Co., 1918.) Price 18*s.* net.

THE speedy appearance of a new edition of this work indicates that it has established itself as a trustworthy and useful aid to practical biochemistry. The chief characteristics of the previous edition, to which attention was directed in NATURE of January 13, 1916 (vol. xcvi., p. 532), remain quite unaltered, and only slight changes in detail have been introduced. These are comparatively few in number, and take the form of modifications of methods of analysis and preparation rendered necessary by new publications. Thus the new methods of preparation of the bile acids, due to Schryver and to Mair, and the latest method of estimating glucose in blood (MacLean), are fully given. A new plate of absorption spectra forms the frontispiece, and includes the spectra of chlorophyll and other leaf pigments, as well as those of the colouring matters of the blood and urine. Appropriately for the times the remarks on diet have been recast, but the few lines devoted to "vitamines" scarcely do justice to the present state of our information with regard to those important dietary constituents.

A welcome addition to the new edition would have been some account of the methods employed in the estimation of the products of bacterial fermentation, a branch of bio-chemistry which has recently become of considerable importance, both from the scientific and the technical point of view. In particular a description of the processes proposed for the determination of mixtures of the lower fatty acids would have been of great value to many workers, although the problem has not yet been satisfactorily solved. A. HARDEN.

Yorkshire Type Ammonites. Edited by S. S. Buckman. The original descriptions reprinted, and illustrated by figures of the types reproduced from photographs mainly by J. W. Tutcher. Parts ix. to xv. (London: W. Wesley and Son, 1913–18.) Price 3*s.* 6*d.* net each.

ALL students of ammonites will welcome this latest addition to Mr. Buckman's work. It contains nearly fifty excellently reproduced figures of as many different species, accompanied by the original as well as detailed modern descriptions. The whole provides as good a substitute for the actual specimens as can be desired.

Seventeen new genera are instituted, the fate of which may be left to the future. It is unfortunate that no guiding principle has been followed consistently in devising new names. In accordance with common practice the majority end in "iceras" or "oceras"; but Geyerina is left as a mystifying exception, which is just as likely to refer to a brachiopod as to a cephalopod. Seven are modifications of the name of the species chosen as the type; thus Bifericeras has biferus for its type. The remainder are not so happily devised. Euhoploceras has *A. acanthodes* for its type. Would not Acanthodiceras have conveyed practically the same meaning, and been much more easily assimilated? *A. luridus* is the type for Beaniceras. What is the objection to Luridiceras?

Among the morphological terms introduced those relating to homeomorphy crystallise our knowledge of this phenomenon and will be valuable for the discussion of other groups of fossils; but the series of terms of which "angustumbilicate" is a sample is more cumbersome and confusing than the descriptive phrases it displaces. The use of a formula to express the relative dimensions of the ammonite and its whorls cannot be excelled for conciseness and accuracy; but the omnibus terms devised to convey the same information have an average range of error of 8 per cent., and their use will render ammonite literature still more unintelligible to the average worker.

Taken as a whole, this work is a most valuable contribution to the science of palæontology.

H. H. S.

Naturforskeren Pehr Forsskål. Af Carl Christensen. Pp. 172. (København: H. Hagerup's Forlag, 1918.) Price 8.00 krone = 9*s*.

THE author of this interesting volume is well known to botanists by his valuable bibliographic work, especially his work on ferns. We have now to thank him for a welcome sketch of the naturalist of the ill-fated expedition to Arabia in 1761 to 1767, which was conducted at the expense of Frederick V. of Denmark.

The volume begins with an account of the expedition and the story of the gradual reduction of the six members to one, Christen Niebuhr being the only survivor. Pehr Forsskål was a Swede, born at Helsingfors in 1732. He was inscribed as a student at Upsala University, where he attended the lectures of Linnæus, but showed so strong a bent towards Oriental languages that in 1753 he migrated to Göttingen, where the celebrated J. D. Michaelis was professor. He was thus equipped both as naturalist and interpreter.

The results of his labours in this capacity are well known, as they were published by Niebuhr on his return to Copenhagen, practically unaltered from the original papers. We have accounts of plants observed in the South of France, Malta, Constantinople, Egypt, and Arabia Felix, until Forsskål's death at Jerim on July 11, 1763, in the thirty-second year of his age.

The text of the present volume is in Danish, but the Appendix of letters from the State Archives is more accessible to most readers because thirty-six letters are in German and the remaining four in French.

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.]*

Weeping Forms of Elm.

A REMARKABLE elm of the variety known as *Ulmus serpentina*, apparently about sixty years old, is now vigorously growing in a Croydon garden. It has this peculiarity, that all its permanent branches are curiously contorted and reflexed, while all the shoots from one to three years old are pendulous rods, which, with the beautiful foliage, form an exterior covering reaching to the ground.

To my knowledge no pruning has been done for the last four years by human agency, and it is highly probable that the tree from its beginning as a graft on a stock of *Ulmus montana* has been allowed always to develop itself without human guidance.

Will someone kindly explain how this tree has been able for many years to maintain its contorted character, seeing that all its young shoots, year after year, are not crooked?

I may add that much dead wood of recent growth falls from the tree every winter, and I have seen that more of the same kind remains entangled in the convolutions of the upper branches.

W. H. SHRUBSOLE.

15 Chatsworth Road, Croydon.

WE are informed that there is an interesting reference by the late Prof. Meehan, of Philadelphia, to a weeping form of *Ulmus americana* in Proc. Acad. Nat. Sci. Philad., 1901, p. 356. Like Mr. Shrubsole, however, Prof. Meehan confines himself to describing facts; he does not give any explanation of them.—ED., NATURE.

"HABITAT GROUPS" IN AMERICAN MUSEUMS.

DR. B. W. EVERMANN, Director of the Museum of the California Academy of Sciences, gives an account, in the *Scientific Monthly* (New York) for January last, of some of the "habitat" or ecological exhibits of mammals and birds which have recently been installed in the museum under his charge, and explains his views with regard to the educational functions of museums. With the latter part of his subject we are not at the moment concerned; but as it is possible, owing to the kindness of the publishers of the *Scientific Monthly*, to reproduce here several of the illustrations which accompany Dr. Evermann's paper, advantage may be taken of this opportunity to direct attention to some of the beautiful results which have been achieved in the United States in exhibiting animals in their natural surroundings. Each illustration has had to have its width cut away by about an inch in order to bring it within the width of a page of NATURE, but even with this reduction the mere inspection of the illustrations in question is sufficient to induce a feeling of unqualified admiration for these efforts; and, from my own personal experiences in the United States, I am able to go further and say that the habitat groups in some of the American museums are fully deserving of the high praise Dr. Evermann claims for them.

FIG. 1.—San Joaquin Valley "Elk" (*Cervus nannodes*). Museum of the California Academy of Sciences.

The system adopted is to illustrate a particular species of animal, or a selection of species living together in the same environment, in a case of sufficient size to include a complete landscape, in which the animals are seen as they actually occur in the field. With this object in view, the museum of the California Academy of Sciences has constructed a large exhibition hall measuring 180 ft. by 60 ft. This is subdivided into two galleries, devoted respectively to mammals and birds. The regulation size for a large case is 25 ft. in width, 12 ft. in depth, and 18 ft. in height, the plate-glass front measuring 15 ft. by 10 ft. The mammal hall contains eleven of these large cases, and the bird hall possesses six, in addition to a series of smaller cases for exhibits on a less ambitious scale.

FIG. 2.—Steller's Sea Lion (*Eumetopias stelleri*). Museum of the California Academy of Sciences.

In most museums the visibility of the objects is interfered with by reflections from the glass fronts of the cases. A window, or a light floor, or a white dress may be reflected so distinctly that these objects appear superposed on the exhibit,

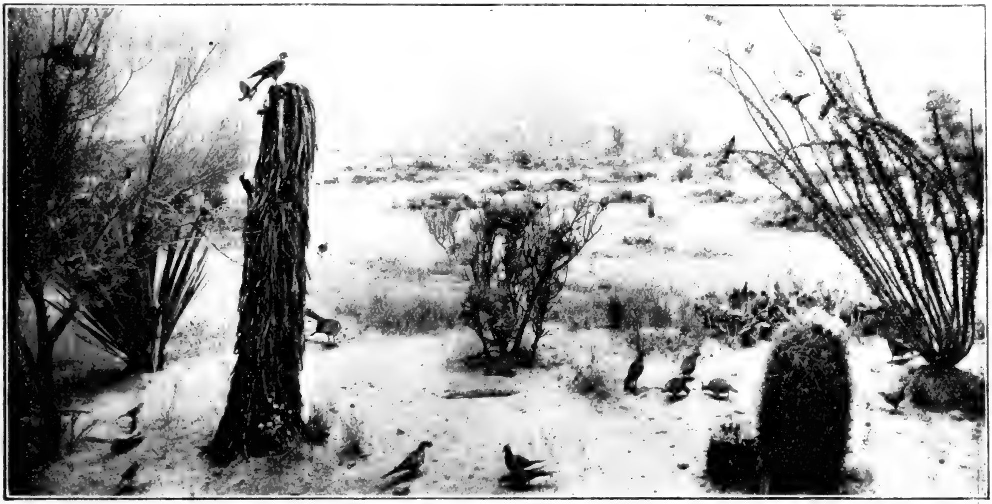


FIG. 3.—Californian Desert Bird Group. Museum of the California Academy of Sciences.

and it is often difficult, or even impossible, to obtain a satisfactory view of the specimens in the case owing to this cause, particularly when the

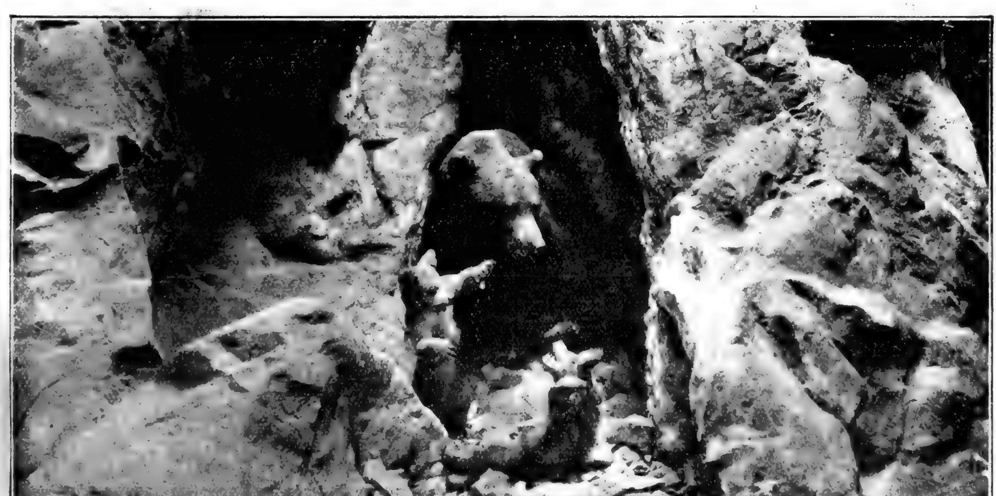


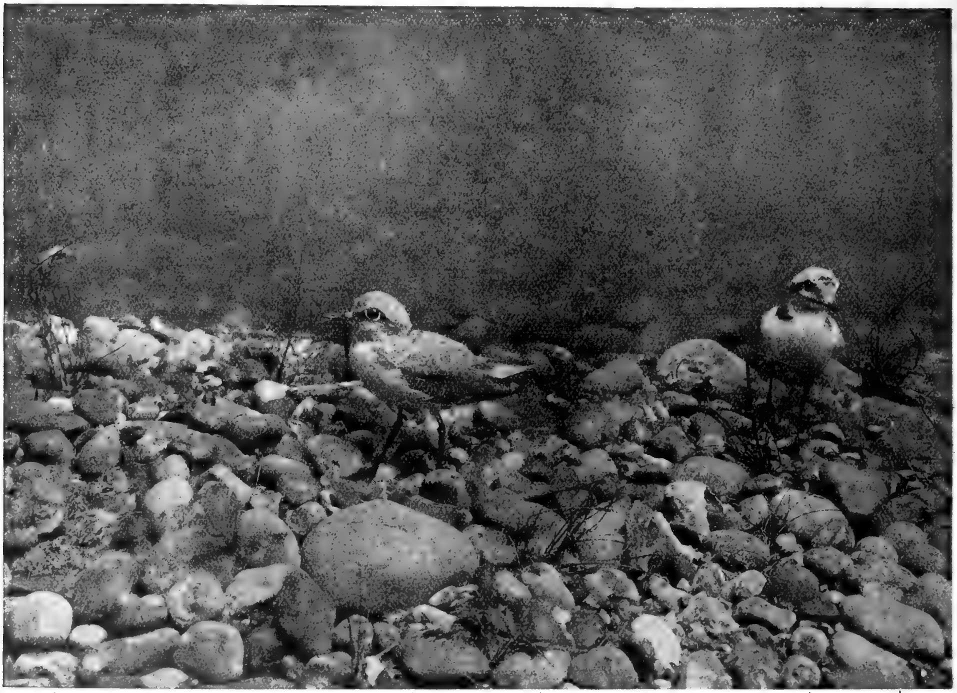
FIG. 4.—Black Bear (*Ursus americanus altifrontalis*). Museum of the California Academy of Sciences.

object inspected has a black surface, which emits so few light-rays that it is overpowered by the stronger reflections seen in the mirror-like front of the case. To avoid these inconveniences, the cases for the habitat groups are arranged against the walls and are lighted by large skylights, while the central part of the hall is provided with skylights of a smaller size, so calculated as to reduce the illumination of objects in the space frequented by visitors to an amount which will give rise to no reflections strong enough to obscure the objects in the exhibition cases. This is substantially the method which has long been in use for the exhibition of living animals in aquaria. Suitable arrangements are provided for reducing the light in the central space on bright days, and for illuminating the cases at night or on dark days.

The general results of the system thus employed may be judged from the photographs here reproduced. The animals occupy the foreground of the case, and are grouped among the "shrubs, trees, flowers, rocks and other objects such as make up a bit of the scenery which surrounds them in the region where they are found in Nature." Some of these surroundings are specimens of actual vegetation, which has been arranged as the result of a careful study of a definite place, and the picture is completed by means of a curved, painted background, "which connects so perfectly with the real objects in front as to make it difficult, if not impossible, to tell where the real ends and the painted begins." The best artists are employed for the preparation of these backgrounds, which are so effective as to complete the illusion that a piece of actual country, with its animal population, has been transferred to the museum.

Among the objects shown in the Californian museum attention may be directed to the group (Fig. 1) of the San Joaquin Valley "elk" (*Cervus nannodes*), a species which formerly occurred in vast numbers in the San Joaquin-Sacramento Valley, California. After having been reduced to a few individuals only, the species was saved from extinction by the enlightened action of the late Henry Miller, who in the early 'seventies took measures for protecting the remnant of the herds, which have since increased to such an extent that they now flourish in a dozen or more reservations in California. In the actual exhibit several individuals of this deer are seen standing or crouching in the grass at the margin of a piece of water surrounded by small trees, with low hills in the distance.

Another group (Fig. 2) illustrates Steller's sea lion (*Eumetopias stelleri*), a species which still visits the famous seal-rocks off San Francisco, although it no longer breeds there. The animals are mounted on a ledge of rocks just emerging from the sea, which is represented with a fidelity making it appear like an actual coast-scene. The great difference in size of the two sexes is well brought out by the individuals selected, the adult male being at least twice as large as the adult female. A bird-group (Fig. 3) representing a scene in a desert region of southern California is particularly effective in bringing out the general features of the birds frequenting this region, as well as the aspect of the desert itself. It may be inferred from the descriptive label of the exhibit that the photograph fails to do justice to what is



Nestlings. Female. Male. Eggs.

FIG. 5.—Kentish Plover (*Aegialitis alexandrina*). British Museum (Natural History).

shown in the museum, since stress is laid on the magnificent colours of the birds themselves and of the flowers which blossom in the desert after the spring rains. The last case (Fig. 4) which can be noticed contains a group of black bears (*Ursus americanus*), represented by a rocky scene, containing the entrance to a den occupied by an adult and its cubs, mounted in singularly life-like attitudes.

Without in the least seeking to take away from the American museums the credit which belongs to them for their successful representations of Nature, it may not be out of place to point out that the system adopted by them is merely the amplification of one which has for many years been in use in this country, particularly in the Natural History Branch of the British Museum. By permission of the trustees of the museum, two figures illustrating the nesting groups so familiar to visitors to the bird gallery in the museum at South Kensington are here reproduced, for comparison with the American exhibits. The group of Kentish plovers (*Aegialitis alexandrina*) (Fig. 5) shows adults, nestlings, and eggs among the stones where the species breeds. It requires some care to discover the nestlings (to the left of the case) or the eggs (on the right side), so closely do they resemble the stones among which they were found. The case of the peregrine falcon (*Falco peregrinus*) (Fig. 6) is another very successful illustration of the nesting habits of a species of bird.

FIG. 6.—Peregrine Falcon (*Falco peregrinus*). British Museum (Natural History).

The essential features of the natural history of a species are really as well brought out in the relatively small cases employed at the Natural History Museum as in the larger exhibits of the American museums, although they do not aim at representing an entire landscape. It may readily be conceded that both systems have their advantages. But while the selection of a smaller case permits of the illustration of the natural history of a large number of species, it is obvious that the limit in number must soon be reached in a museum, even one of the largest size, which mounts its exhibits on the scale adopted in the American museums. The question of cost is, moreover, one which cannot be ignored by any institution which is not provided with the most ample funds, and one would like to have been informed what has been spent in the production of the beautiful exhibits described by Dr. Evermann. It is unfortunately probable that economy in administration will be imposed on museums even after the conclusion of the war. Should it be suggested that it is the duty of museums in this country to imitate the American example, it must be remembered that the expenditure of large sums of money in this way would divert funds from other purposes which might be of more pressing importance.

S. F. HARMER.

THE CEREAL BALANCE.

As the harvest year of 1917–18 approaches its end the question of the relation between supplies and rate of consumption of bread-corn assumes increased interest and importance. Europe and North America are breaking into their last reserves of home-produced cereals of the 1917 crop. If these prove inadequate to meet requirements from the present time until August next, what is the world reserve available to bridge the gap between the old and the new crop? The reply is given by the International Institute of Agriculture in a valuable analysis of supplies and requirements recently issued.[1] The analysis covers the agricultural season beginning with August, 1917, and ending with July, 1918, and is based upon returns as to production and estimated consumption of cereals in all important countries where international trade has been maintained, including, therefore, all Entente and neutral countries, but excluding Russia and Roumania.

As regards supplies, the relative yields of cereals in 1917 (northern hemisphere) and 1917–18 (southern hemisphere) as compared with the previous season (*a*), and with the average of the three preceding seasons, 1914–16 (*b*), are shown by the following summary:—

	(*a*) per cent.	(*b*) per cent.
Wheat	103·2	90·4
Rye	94·2	91·7
Barley	103·8	101·3
Oats	114·0	110·6
Maize	121·0	113·3

In the aggregate the cereal crops of 1917 show an increase of 223 million quintals over 1916, or 72 million quintals over the average of the three years 1914–16, the increases being mainly due to last summer's abundant crops of oats and maize in the United States. Wheat alone shows an increase of 19 million quintals over 1916, and a decrease of 64½ million quintals as compared with the three-year average.

To these supplies the carry-over from previous crops needs to be added, but very few countries have been able to show any such reserves in excess of the usual carry-over, Australia being the outstanding exception.

When these estimates of supplies are compared with the estimates of requirements up to next harvest supplied to the institute by the various Governments, the following margins of assets over liabilities (in millions of quintals) are shown for the different crops:—

Wheat ...	44½	Oats ...	62½
Rye	2½	Maize ...	157
Barley ...	12½		

or a total reserve of assets beyond requirements of 279 million quintals. The preponderance of oats and maize in this surplus is a factor to be considered in determining its real value. The light natural weight of the oat grain interferes with transport under conditions of shortage of tonnage, and consequently in many countries the consumption must be limited to the home-growth, within a very small margin. The handsome surplus of maize is the result of the very large crop of the United States, but so far it has unfortunately been most difficult to transport owing to the risk of heating consequent on an abnormally high moisture-content.

Earlier forecasts of the situation suggested the probability of an actual deficit of supplies, and it is all the more welcome, therefore, to find, now that more trustworthy data are available, that so far from this being the case the world, taken as a whole, has ample supplies to meet all its requirements.

The real gravity of the situation lies in the fact that the large reserves are in a few countries, such as Australia, Argentina, British India, and North America, while there is a large deficiency in Europe. Transportation is notoriously surrounded with difficulties owing to the scarcity of tonnage and the enormous rise in rates of ocean freight. The cost of carrying a quarter of wheat from Argentina to Great Britain is twenty times what it was before the war, and other freights have advanced in like manner.

It is clear, therefore, that the disclosure of a substantial world reserve of cereals in no way diminishes the need for the utmost effort to extend cereal production and to economise in cereal consumption in the countries where a deficiency exists and in countries nearest to them. The greater the success of this effort the more effective will the world reserve be in augmenting supplies and reducing prices in the future when a greatly increased tonnage becomes again available for the grain trade.

[1] "Statistical Notes on the Cereals," No. 7, pp. 136. (Rome: Internat. Inst. Agric., 1918.)

DR. G. K. GILBERT.

On May 1 a very notable figure passed away from the field of geological discovery and research. Dr. Grove Karl Gilbert was born in Rochester, N.Y., in 1843, and had thus almost completed his seventy-fifth year. In his "Report on the Geology of the Henry Mountains," issued by the U.S. Geographical and Geological Survey of the Rocky Mountain region in 1877, he developed the theory of the expansion of intrusive igneous sheets into the great cauldron-like masses that he conveniently styled "laccolites" (stone cisterns), and the rapid recognition of laccolites throughout the world bore witness to the cogency of his exposition. From 1879 onwards he was attached to the staff of the U.S. Geological Survey, and it is not too much to say that his reports helped considerably to direct general scientific attention to the earlier publications of that body. His "Contributions to the History of Lake Bonneville" in 1882, and his monograph on "Lake Bonneville" in 1890, became classics for the treatment of vanished lakes in other areas, and also raised important questions as to crustal yielding under load.

An excellent example of Dr. Gilbert's approach to difficult problems may be found in his study of the origin of the features of "The Moon's Face," in a presidential address to the Philosophical Society of Washington in 1892. In 1890 he had described the history of the Niagara River for the Commissioners of the State Reservation, and in 1907, when schemes for utilising the water-power of the falls threatened the normal continuation of their erosive action, he reported on their rate of recession both on the Canadian and on the American side. Almost simultaneously his unfailing judgment was called on to investigate the disastrous earthquake of 1906 at San Francisco. Among his later work may be cited an experimental study on river-transport (U.S. Geol. Surv., Professional Paper 86, 1914).

Dr. Gilbert was a man of strong build and fine presence, equally considerate to his colleagues and to the younger workers whom his methods and personality inspired. Those who were privileged to meet him in various lands will readily acknowledge that he was and remains one of those who have well deserved the title "great."

GRENVILLE A. J. COLE.

NOTES.

THE report of the council of the British Association was received and adopted at the statutory meeting of the general committee held on Friday last, July 5. Much disappointment was expressed that no ordinary meeting had been held for the second year in succession, and a resolution was adopted unanimously asking the council to arrange for a meeting in London next year if it should not be possible to meet at Bournemouth. It was left to the council to decide whether the meeting should be of the usual kind, with the various sections of the Association in session, or should take the form of a conference at which some of the national aspects of scientific work would be presented. We urged the desirability of a London meeting several months ago, and are glad, therefore, that the general committee has expressed itself so decidedly in favour of it.

SIR EDWARD SCHAFER, professor of physiology in the University of Edinburgh, wishes it to be known that he is adopting the name of Sharpey before the surname of Schafer.

WE regret to see the announcement of the death, on June 29, at sixty-five years of age, of Prof. Alfred Senier, professor of chemistry and lecturer in medical jurisprudence and hygiene in University College, Galway.

PROF. J. N. LANGLEY, professor of physiology in the University of Cambridge; Sir F. W. Dyson, Astronomer Royal; Prof. Horace Lamb, professor of mathematics in the University of Manchester; and Sir E. Rutherford, Langworthy professor of physics in the University of Manchester, have been elected foreign members of the Reale Accademia dei Lincei, Rome.

WE regret to record the death on June 24 of Prof. F. P. Treadwell, professor of analytical chemistry at the Polytechnic Institute, Zurich. Prof. Treadwell was a native of the United States, where he was born in 1857. He came early to Europe, and entered the University of Heidelberg in 1875, graduating three years later. For some time he acted as lecture assistant to Bunsen, and then proceeded to Zurich, where he served in a similar capacity under Victor Meyer. Eventually, in 1894, he received the appointment to a professorship, which he retained until his death. During his long stay of more than thirty years at Zurich Prof. Treadwell became a well-known and respected figure in the town. His name is familiar in this country and abroad by reason of his two-volume treatise on analytical chemistry, of which eight editions have appeared. That he retained an active interest in the branch of chemistry to which he had devoted himself is shown by the fact that not long ago, with a collaborator, he worked out a new method for estimating thiocyanic acid and hydrogen sulphide iodometrically.

AMONG the points discussed by Lord Moulton in his presidential address to the Institute of Gas Engineers on June 4 was the question of replacing the existing statutory illumination standards for coal-gas by standards based upon calorific value. With the use of the incandescent mantle now almost universal, it has become immaterial whether gas possesses illuminating power or not. The effect of the mantle depends on the calorific value of the gas, not on its light-giving properties. Provided that the gas will give out the requisite heat to raise the mantle to its proper degree of incandescence, the illumination obtained is from six to eight times that given by gas of statutory quality when used without the mantle. The illuminating properties, moreover, are conferred upon gas by the heavy hydrocarbons (olefines and benzene), which could be better used in other ways—partly as fuels, partly as a source of the important hydrocarbons which yield us our dyes, explosives, and other chemical products. That a large portion of these valuable substances should be sacrificed in imparting to coal-gas a property which has ceased to be of value is a loss to the community which should not be allowed to continue.

AT a symposium of the Zoological Society of America two addresses (reported in *Science*, May 17, pp. 473–81) were delivered on the value of zoology. In one of these Prof. M. F. Guyer, of Wisconsin University, deals with the utilitarian value, shrewdly premising (1) that widening the intellectual horizon and casting out the twin devils of superstition and ignorance are more useful gains than those which make for material well-being; and (2) that nowhere outside zoology "are there greater opportunities for developing that questioning, impartial, problem-solving attitude of mind which must obtain, if truth and sanity are to rule the world." He then proceeds to give vivid illustrations of the contributions zoology has made to the problems of health and disease, agriculture and animal husbandry, the conservation of natural resources, the utilisation of fisheries, and human eugenics. The other address, by Prof. H. B. Torrey, of Reed College, deals with the value of zoological science to the individual—the mythical average man—as organism, as citizen, and as personality. He justly sets great store on the educative value of getting, or trying to get, a clear view of distinctively biological concepts, such as organism, growth, development, behaviour, adaptability, evolution. These are all vivid, dynamic conceptions, the lack of which has often been a handicap, even to minds of the first rank. He indicates that amelioration of human life must have a scientific foundation (though other than cognitive factors may also be fundamental), and that zoology includes a vast realm of important facts bearing on or directly touching this complex life of ours. On another tack he points out that zoology is rapidly progressive, with problems for all comers to work at, a wholesome stimulation to all intellectual combatants. In biological science, in part because of its youthfulness, there are great possibilities of a return to "a wholesome apprenticeship as in the days when students were the assistants of their masters, shared their hopes and ambitions, and felt the stimulus of their creative activity." There is here the touch of "The Third Floor Back"—for students as well as for teachers.

In the Bankfield Museum Notes, second series, No. 10, Mr. H. Ling Roth continues his studies in primitive looms by an account of those of Indonesia. The loom of this region belongs to the Pacific type, of which the most important are the American and the Ainu. Taking the area in a wide sense, there appear to be three forms of loom in Indonesia—the Dusun and Iban (Sea Dayak) looms, the Ilanun and Igorob transition loom, and the Cambodia and Malay loom. Of these the Dusun and Iban loom is the most primitive, consisting of a warp beam attached to two upright posts, a breast beam attached to a back strap, several laze rods, a shed stick, one "single" heddle, a beater-in, a temple, and a spool. The warp is continuous, and the weaver sits on the floor. The monograph is, as with others in the series, provided with several excellent illustrations from drawings.

In a paper republished from the Proceedings of the British Academy (vol. viii.) under the title of "Cosmic Law in Ancient Thought," Prof. T. W. Rhys-Davids discusses the question of animism as defined by the late Sir E. Tylor. This is merely another name for the soul-theory, but it was a great advance to replace the ambiguous expression "soul" by a new scientific word which could be used in a definite sense. There is, however, a group of facts which cannot be included in this definition—those behind which is a single underlying principle, the belief in a certain rule, order, or law. Thus, among the Chinese, the fact of a boy having a hare-lip was explained to Prof. de Groot as resulting from the child's mother having during her pregnancy accidentally made a cut in an old coat of the father's she was mending. This is a definite law of causation, however absurd it may appear. For cases of this kind Prof. Rhys-Davids proposes the term "normalism," which is convenient, and will probably be included in the nomenclature of comparative religion.

Mr. Waino Pekkola, who during the last four years has been engaged in the study of the fish fauna of the Nile, publishes in Sudan Notes and Records, No. 2, April, 1918, a report on the "Seasonal Occurrence and Edibility of Fish at Khartoum." At present nearly 200 species are known to exist in the Nile system, but only a small number of these occur in the rivers near Khartoum, and still fewer are constantly present throughout the year. The most abundant are the Siluridæ or cat-fishes, of which the commonest is Synodontis, Schall. Almost as abundantly represented is the family Mormyridæ, all the members of which are African fish. Of the Cyprinidæ there are four species of Labeo. Of the Cichlidæ *Tilapia nilotica* has a wide distribution from the Sea of Galilee and the River Jordan all over the Nile system. The salting of fish is at present carried out only to a small extent in the Sudan, but many of the small species of the genera Barbus and Alestes would be valuable as food if salted in a proper manner.

The British Museum (Natural History) has just issued the report on the Arachnida collected during the British Antarctic Expedition of 1910. The few specimens collected were obtained during the voyage out, from a rocky island off South Trinidad, and on the return journey from New Zealand. Mr. H. R. Hogg, to whom the specimens were submitted, remarks that, unfortunately, nearly one-half of the South Trinidad specimens have not reached maturity. This renders their determination uncertain, and consequently precludes any clear indication of the source from which the fauna had its origin. The island is situated in the belt traversed by the south-east trade winds, and the families represented are mostly those the members of which are carried long distances by the wind. Two new species were included in this collection.

Two papers of considerable interest to ornithologists appear in the *American Museum Journal* for April. In the first of these Messrs. Herbert Lang and James P. Chapin describe the nesting habits of the African hornbills. While confirming much that has already been recorded on this theme, the authors have been enabled to add further details as to the extraordinary nesting habits of these birds. The most striking of these is contained in their assurance that the incarcerated female adds to the thickness of the mud wall used to diminish the entrance to the nesting hole by plastering the inner walls with excrement, containing the chitinous parts of insects and the seeds of forest trees. They also show that the female does not undergo a complete moult during her imprisonment, though this has been generally supposed to be the case. In the second paper Mr. Edward Forbush describes the courtship dances of the heath hen (*Tympanuchus cupida*). The curious sounds emitted by the bird during the display cannot be satisfactorily accounted for, but they are evidently due, in part at any rate, to the inflation of the cervical air-sacs, since no sound is emitted when these are punctured. Some remarkable photographs add considerably to the value of this very careful record.

The British Museum (Natural History) has recently issued the fifth report on Cetacea stranded on the British coasts. The report, compiled by Dr. S. F. Harmer, keeper of the department of zoology, records the whales stranded during 1917. The most interesting specimens were a white-sided whale, from Lincolnshire, believed to be the first specimen recorded from the English coast; a large sperm whale from Caithness; a Cuvier's whale (*Ziphius cavirostris*) from Co. Clare; and a Risso's Grampus from the south coast of Devon. Examples of the bottle-nose whale (*Hyperoodon rostratus*) were recorded from Caithness, from Cork, and from Dorset, and Dr. Harmer discusses in some detail the occurrence of this whale on the British coasts, which generally takes place during late summer and autumn, the specimens being usually adult females accompanied by a calf. Most of the records have been obtained from information provided by the coastguards, but it is hoped that amateur naturalists will take an interest in this question and see that information as to any Cetacea stranded on the coast is sent to the Natural History Museum. The interesting record of Risso's Grampus on the Devonshire coast would have been lost but for the vigilance and careful examination of Mr. F. Beynon, of Torquay.

We have recently received the first number of a new periodical, the *South African Journal of Natural History*, which is the official organ of the South African Biological Society. This society was formed in the latter part of 1916, and with it were amalgamated the South African Ornithologists' Union and the Transvaal Biological Society, with the object of making a strong body to advance the study of biological questions in the Union of South Africa. The South African Ornithologists' Union was started in 1904, and has issued twenty-two numbers of its journal, which contain much valuable information in regard to the avifauna of South Africa; the Transvaal Biological Society, which was founded in 1907, has held a number of meetings in Pretoria, to which many papers and demonstrations have been submitted, but it has not issued any publication of its own. The new journal, which is edited by Messrs. A. K. Haagner, I. B. Pole Evans, and Claude Fuller, contains a number of useful papers, chiefly on ornithological and entomological subjects. Lieut. G. C. Finch-Davies writes on the birds of the districts of Okanjande and Outjo, in the South-West African Protectorate, formerly German South-West Africa, a region much neglected since the days of C. J. Andersson and F. Eriksson, who collected in the sixties and seventies of the last century. Other bird papers are contributed by Messrs. C. F. M. Swynnerton and R. Godfrey. Mr. Haagner describes a new baboon (*Choiropithecus rhodesiae*) based on an animal living in the Zoological Gardens at Pretoria, and illustrated by a photograph—a rather hazardous proceeding, perhaps, while the animal is still alive. Among the entomological papers are one by Mr. R. W. Jack on the larvæ of some Rhodesian Tenebrionidæ, and one by Mr. C. N. Barker, in which attempts are made to explain some irregularities in the phenomenon of seasonal dimorphism among butterflies. Altogether the part, which consists of 122 pages of well-printed text, is a welcome addition to the list of zoological publications, and, we hope, will continue to appear and to maintain the high standard it has set itself.

In view of the increasing restrictions upon the importation of wheat, the Department of Agriculture for Trinidad and Tobago has issued a leaflet entitled "Our Local Foods and How to Use Them," which urges economy in the use of wheat-flour and the more extensive use of native plants—sweet potatoes, yams, cassavas, dasheens, and others—as human food. The leaflet embodies many of the recommendations of the British Guiana Flour Substitutes Committee, which was appointed in 1917 to investigate the possibility of procuring locally grown products as substitutes for wheat-flour. The report of this Committee, which was published in the Bulletin of the Department of Agriculture for Trinidad and Tobago (vol. xvi., part 2), states that the products of tropical origin which most nearly approach wheat-flour in food value are rice, guinea-corn, and maize, but it is not possible to make bread of these alone; they can be employed only in the preparation of cakes. On the other hand, these products, and, in addition, cassavas, sweet potatoes, and tannias, are useful adjuncts to imported flour, and by their general use in bread-making it was calculated that the amount of wheat-flour imported in 1916–17 might be reduced to half in 1918. The economical feeding of stock is also strongly urged by the Department of Agriculture, as in 1914 oats and cattle-food to the value of 70,000*l*. were imported. As a substitute for oats, farmers are recommended to grind unshelled corn and to supplement it with locally grown peas and beans, as this practice should reduce the imported cattle-fodder to about one-fifth of its present amount. The high price of food has largely increased the area of land under cultivation in Trinidad, and the Government has recently offered rice lands at a nominal rental, so that the colony should become in the future largely self-supporting.

A severe earthquake, of which very few details have as yet reached this country, occurred at about 6 a.m. (G.M.T.) on February 13 in Swatow, on the southern coast of China, by which several hundred persons were killed and more than a thousand injured. An account of the earthquake, written for the most part in Japanese, is given by Mr. K. Hasegawa in a recent issue (March, 1918) of the Journal of the Meteorological Society of Japan. The position of the epicentre, as determined from records obtained in Japanese observatories, is in lat. 24° N., long. 116° E.

That the duration of the preliminary tremor of an earthquake varies with the distance of the epicentre has long been known, though, for earthquakes with neighbouring origins, no simple formula has been devised for estimating the distance of the epicentre from the duration of the tremor. From a discussion of forty-one recent earthquakes in Japan, Prof. Omori shows (Bulletin of the Imperial Earthquake Investigation Committee, vol. ix., 1918, pp. 33–39), that, when the distance does not greatly exceed 1000 kilometres, the distance of the epicentre in kilometres is very nearly 7·42 times the number of seconds in the duration of the preliminary tremor. The only exception within the limit mentioned is that if the duration is less than one second the coefficient should be 6·0.

Mr. J. B. Tyrrell (Trans. Roy. Soc. Canada, vol. xi., p. 39, 1917) concludes that the deep vegetable deposits known as "muck," resting on permanently frozen gravels in the Klondike district, began to accumulate at the very opening of the Glacial epoch. The supply of gravel through river action was then cut off, and conditions were established which have lasted down to the present day. The permanently frozen substratum furnished an impervious foundation, on which sufficient water gathered in spring to allow of the growth of Sphagnum and Hypnum, while the streams from the hill-slopes washed down into the flats representatives of the forest flora of the district.

Mr. P. W. Stuart-Monteath (*Comptes rendus*, January 7, 1918) gives reasons for assigning a Cretaceous age to a large extent of limestone, once regarded as Carboniferous, in the "Détroit de la Navarre," a transverse band of sediments separating the Pyrenees from the Basque ranges. He concludes that a great series of intrusive ophites and lherzolites is responsible for the local silicification of various rocks, and that the intrusions are posterior to the Hippurite-limestone and to an overlying conglomerate. The conglomerate contains blocks of ophite, which are interestingly regarded as due to volcanic explosions prior to the veins that were finally injected in the mass from the same subterranean cauldron.

Although a number of weakly magnetic minerals such as zinc-blende are known to be attracted by strong magnetic fields, but little is known as to the degree of magnetisation obtainable. Three investigators describe in *Metall und Erz* for January 8 a method of measuring the susceptibility of such minerals. Zinc-blendes of different varieties were found to have widely varying susceptibilities, some being below 10^{-6} and some as high as 500×10^{-6}.

In the *Revue générale de l'Electricité* for May 18 methods are described to enable electric generating stations to transmit signals over their systems. These signals could be used for such purposes as time-signals, synchronising clocks, or giving any other pre-arranged signal, such as air-raid warnings, etc. The signals consist of a series of periodic variations of voltage, the magnitude being small compared with the line voltage.

At the present time, when oils and grease are of so much importance economically and industrially, a writer in *La Nature* for April 27 describes a new process, invented by an Italian (Prof. Lotrionte), that has proved most successful in exterminating the olive-fly, which annually destroys about 80 per cent. of the crop. Small wooden boxes are fastened to the tree, and beneath the cover of each box is fixed a bunch of straw. The straw is spread with an insecticide, of which the formula is given. The result has been to reduce the losses to 10 per cent.

FOR the past few years Swedish seaweed has been coveted by the Germans, who, by chemical treatment, made it into fodder, and also extracted valuable chemical products from it. A number of experiments have been made at Stockholm, according to the *Svenska Dagbladet* for May 12, and it has been found that by dry distillation of 1 kg. of dried seaweed the following substances can be extracted :—30 to 32 litres of illuminating gas, 43 per cent. of carbon, 45 per cent. of distillates (acetic acid, methylated spirit, formic acid, acetone, etc.), 14 per cent. of salt (sodium sulphate, potassium sulphate, potassium chloride), also iodine, bromine, a very aromatic tar product, and carbolic tar (creosote?), an excellent preservative of timber. A factory is about to be started by the Focus Co. to take up the conversion of seaweed on a large scale.

WHEN a sphere or other solid symmetrical about an axis performs torsional oscillations about that axis in a viscous liquid it is found that the logarithmic decrement of the oscillation is not constant until the oscillation has died down to less than 0·01 radian, and becomes difficult to measure with the necessary accuracy. Determinations of the viscosity of the liquid from the value of the decrement on the assumption that the oscillations died away according to the simple exponential law have generally given too high results. In Communications from the Physical Laboratory of the University of Leyden, No. 151, Dr. Verschaffelt shows both theoretically and experimentally that the oscillations require at least three terms of the form e^{-nkt}, where e is 2·718, t is the time, n has the values 1, 3, 5, etc., and k is a complex quantity involving the viscosity of the liquid. With this theory as a basis he is able to show that the viscosity of liquid hydrogen at 20° Absolute is 0·00011—that is, about one-hundredth part of that of water at 15° C.

UP to ten years ago our knowledge of the distribution of the electric potential in a vacuum tube through which a discharge was passing was derived from observations with an exploring electrode, but in 1909 Sir Joseph Thomson introduced the more trustworthy method of determining the electric field in a tube by discharging cathode rays across it and measuring the deflection of the rays produced by the field. Using this method, Aston in 1910 found the field in the cathode dark space proportional to the distance from the edge of the negative glow, while Harris in 1915 found it increased much more rapidly as the cathode was approached. Messrs. T. Takamine and U. Yoshida, in the October issue of the Science Memoirs of Kyoto University, give the results of their measurements of the field in narrow tubes by the widening or separation of spectral lines photographed across the field, a method due to Lo Surdo. They find that the field at a point distant d from the end of the dark space exceeds the field at the end by a quantity proportional to d^2. The curves given in the paper show that this law is a close approximation to the facts.

THE May issue of the *Lyonian* (the magazine of the Lower School of John Lyon, Harrow) contains the report of a lecture on "Chemical Change" delivered by Mr. O. A. Le Beau at a meeting of the school scientific society. The lecturer commenced by pointing out that chemical change is of universal and never-ending occurrence, and then differentiated it from physical change. The five different types of chemical change, direct union, decomposition, polymerisation, single replacement and double replacement, were defined, and so far as possible illustrated by experiment. The phenomenon of catalytic action was shown experimentally, and also the action of light upon chemical change. Such a recent development of the action of electricity as the production of "active nitrogen" was illustrated by a repetition of Prof. Strutt's original experiment. We think it commendable that the school possesses a science master who evidently keeps abreast of modern research, and that such a lecture, involving much work in its preparation, should be so enthusiastically received.

WE have received a reprint from the Journal of the West of Scotland Iron and Steel Institute of a paper recently read by Dr. Desch on "Attempted Improvements in the Puddling Process." As Dr. Desch points out, the process of manufacturing malleable iron by means of puddling, invented by Henry Cort in 1784, has undergone surprisingly little alteration in the course of its history. It is still performed in units of small size owing to the fact that manual labour is employed for the manipulation of the metal, and the quantity dealt with cannot exceed that which a man can handle without the aid of machinery. Certain details of Cort's original process have been modified, and have produced an important effect on the development and manufacture, but the principle has remained unchanged. The present report does not deal with such improvements as those which have led to the puddling furnace of the present day, but is an attempt to collect information concerning proposals which have aimed at altering the character of the process, either by lessening the manual labour involved or by increasing the thermal efficiency of the furnace. Few of these suggested improvements, however, have been adopted permanently even on a limited scale, and the type of furnace in universal use differs less from that used at the beginning of the nineteenth century than from most of the proposed substitutes for it. Undoubtedly the most important of these modifications was the Danks furnace, which was a practical success, and its failure to maintain its ground was due, not to any inherent defects, but chiefly to the abandonment of iron-making in favour of steel by those firms which had formerly shown the greatest interest in the problem, and had come nearest to solving it. Dr. Desch's paper is an interesting summary of the subject, and should be of great service.

THE assistance which America is rendering to the Allies in the matter of shipbuilding is illustrated by articles in the *Engineer* and *Engineering* for June 28, descriptive of the world's largest shipyard at Hog Island, on the Delaware. The land on which this shipyard stands was virgin on September 20, 1917; the twenty-first slipway is now in use, and twenty-nine other slipways are in course of construction. A shipyard capable of having fifty ships on the stocks at one time was a thing quite undreamt-of until last year, and suggested the visions of Jules Verne rather than the plans of sane business men. Yet it is now in a fair way of accomplishment, and the estimate may be accepted of fifty ships being built simultaneously, while twenty-eight others are being fitted out at seven piers each of a length of 1000 ft. When that stage is reached there will be a launch every other day, either of a 7500-ton cargo ship or of an 8000-ton combined troop and cargo boat. The site covers 846 acres, and extends over two miles of river front. The various parts of the vessels are being "fabricated" all over the States at 3500 different works, some of them so remote that the average journey takes as many as twenty days. Within five months of commencing operations 26,000 men were employed on the construction of the yard. The site is well inland, away from possible enemy attack.

OUR ASTRONOMICAL COLUMN.

The New Star in Aquila.—Further particulars of the observation of Nova Aquilæ by Prof. Laskovski at Geneva on June 7 have been given in Circular No. 25 of the Marseilles Observatory. The star was observed at 9.45 p.m. mid-European time, and was described as being white, and of a brightness greater than that of α Ophiuchi (mag. 2·1), but less than that of Altair (0·9). This would appear to be the earliest observation so far reported. Subsequent observations agree with those made elsewhere in showing that the star was brighter than Vega on June 9, and had dwindled to about 2nd magnitude by June 18. It is added that the region was under observation by M. Dumastberay at Nyon on June 3 and 4, and that nothing abnormal was then noted.

There appears to have been a slight recovery in brightness of the nova at the beginning of the present month. Mr. Denning found that after reaching mag. 3·75 on June 29 there was a decided increase in brightness to mag. 3·5 on July 1. With possibly slight variations the star remained at about this brightness up to July 8. The check in the decline of the nova occurred at about the same interval after maximum as in the case of Nova Persei, and it will be interesting to see if Nova Aquilæ will now similarly assume the characteristics of a variable star. The bright lines of hydrogen have continued to dominate the visible spectrum, and no striking changes in detail were noted by Prof. Fowler between June 29 and July 8 except that the reversal of the hydrogen lines was no longer clearly visible. The band in the blue near λ 464 remained a conspicuous feature during this period, and was possibly increasing in relative brightness. The relative brightness of the line 502, however, did not appear to have notably increased.

Photographs of the spectrum obtained by the Rev. T. E. R. Phillips have shown remarkable changes in the structure of the bright bands of hydrogen. On June 13 and 15 the bands had a bright central stripe, with bright companion lines on both sides; on June 22 they were single, but broad; on June 26, 27, and 29 they were double, as if centrally reversed, and the less refrangible components were the brighter; and on July 2 they were again single, but broad. The band about λ 464 appeared as early as June 13, and has continued to brighten; it passed through changes of structure similar to those exhibited by the hydrogen bands. A new bright band appeared on July 4 on the more refrangible edge of a broad, dark space on the violet side of Hγ.

Ephemeris of Wolf's Periodic Comet.—Attempts to find this comet have hitherto been unsuccessful, but as its distance from the sun and earth is steadily diminishing, the comet is likely to be found before long. The following ephemeris is from Mr. Kamensky's elements:—

G.M.T.	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
July 12·46	20 32 52	24 50	0·3368	0·1376
24·64	20 26 3	26 28	0·3217	0·1017
Aug. 5·49	20 17 1	26 45	0·3073	0·0724
17·01	20 8 27	25 50	0·2936	0·0499
28·17	20 2 27	23 52	0·2803	0·0338

The New System of Time at Sea.—Mr. F. Jacob suggests the term "Intermeridian Time" for the new system, with the abbreviation I.M.T., so that 4h. 7m. I.M.(+3)T. would be equivalent to 7h. 7m. G.M.T. The suggestion has met with favourable consideration from the Admiralty Committee on the subject. The term "Intermeridian" is unobjectionable for denoting the regions that keep the same time, but its length will probably hinder its general adoption for this purpose.

CONFERENCE OF CORRESPONDING SOCIETIES OF THE BRITISH ASSOCIATION.

The annual conference of Delegates of Corresponding Societies of the British Association was held in the Geological Society's rooms, Burlington House, on Thursday, July 4. At the morning session Dr. F. A. Bather gave his presidential address entitled "The Contribution of Local Societies to Adult Education." In this Dr. Bather endeavoured to summarise the membership and estimate the strength of the various scientific societies in Great Britain, show the part they were playing in the adult education of the country, and make suggestions for the further usefulness of these societies. His statistics had been difficult to compile and were admittedly incomplete, but it was demonstrated that while some centres were well provided for in the way of natural history and allied science societies, there were many large areas which appeared not to be served by any societies of the kind. Discussion was invited, which lasted for the remainder of the morning. The general feeling was that, desirable as it is that everything should be done to increase the popularity and work of our scientific societies, the present time was inopportune, seeing that so many of the young and vigorous men were occupied with more important duties. In his reply to the discussion the president attached particular importance to the remarks made by the delegate from Hull, in reference to the excellent work being accomplished in Yorkshire, where there are far more important societies than in any other county. It was pointed out that, notwithstanding the elaborate and systematic instruction in Nature-study in the schools, and the formation of Nature-study societies for teachers, the result was unquestionably that there was less apparent interest taken in natural history by young men and women after leaving school, and even before the war the membership of the societies had shown an apparent decrease. The conference decided to endeavour to prepare a list of all the scientific societies in the country.

At the afternoon session Mr. Martin C. Duchesne read an admirable paper on "Afforestation," Sir Charles Bathurst and many of the delegates taking part in the discussion. The lecturer dealt at length with the urgent question of the increase of our home forests, and made many excellent suggestions towards the accomplishment of this. It was felt that the delegates could get the societies they represented to use their influence to further the growth of timber throughout the country, and one practical proposition was made, namely, to form an Arbor Day throughout the country. Such a suggestion, made on July 4, was also complimentary to our American friends, who have had an Arbor Day for many years. A short note from Mr. P. Westall, who was not present, was read, the gist of which seemed to be that some authority should make grants to local museums, but how and by whom these grants should be made the author did not seem to know, and the delegates did not appear to be able to help him. On behalf of Mr. B. B. Woodward a "typomap" of the British Isles was exhibited, upon which naturalists may record the distribution of species. This will probably be circulated among the various societies.

More than one member commented on the fact that this year, when the necessity for directing attention to the national value of science seemed so great, the British Association *for the advancement of science* had decided to have no general meeting.

THE FUTURE OF THE ENGINEERING TRADES.

THE Report of the Departmental Committee appointed by the Board of Trade to consider the position of the engineering trades after the war has recently been issued (Cd. 9073, price 6*d*. net).

The report relates to one of the largest and most important of the national activities. It is chiefly concerned with fiscal, commercial, and labour questions. The Committee estimates the annual net value of the output of the engineering trades, excluding the cost of materials, at 84,000,000*l*., and the real value at 144,000,000*l*.

The Committee remarks on the smallness of many individual firms, in consequence of which they manufacture at a cost which could be greatly reduced if they were on a larger scale, well planned and well equipped; also, that adequate departments for research are necessary, but that small firms cannot bear their cost. The Committee regrets the spirit of exclusiveness which has marked the engineering trade, each manufacturer keeping his own secrets and desiring to retain the knowledge of any special processes and methods for himself.

It is urged that standardisation must be extended. For instance, locomotive manufacturers exist almost entirely on foreign trade, the great railways constructing those they require. But, except in the case of India, locomotives are not standardised, and British engineers employed by foreign railways require modifications of their own. German and American manufacturers build to stock with economy of drawings, patterns, templates, etc. The case of imports of watches is curious. The average value of imported watches from Switzerland is 6*s*. each, and the total value more than a million pounds. The British manufacturer does not seem prepared to supply a good, cheap watch.

The Committee decides against the compulsory adoption of the metric system on the grounds that the expense would be great, and that any change should be effected after agreement with the Dominions and the United States. But it recommends that subdivisions of the inch should be decimalised, and the hundredweight and ton replaced by the cental and short ton.

The recommendation that school education between the ages of fifteen and seventeen should be confined to selected boys does not go so far as Mr. Fisher's Education Bill. As to higher education, the views of the Committee are more advanced. But it is pointed out that the monetary results which can be achieved by a graduate of the technical or scientific side of a university are incommensurate with the expense incurred, and that the rewards for higher technical education are still far too small.

As to the much-discussed question of dumping, the Committee expresses a decided view. It thinks that all necessary steps should be taken to prevent dumping wherever practised, and refers with approval to the legislation in the United States and Canada.

An account is given of the German system of cartels, under which a manufacturer is able to maintain a reasonable output in bad times, and in the case of articles for export receives a rebate in price on raw and semi-manufactured materials. Also, in Germany there are reduced railway rates on goods for export. It is urged that the Government should supervise, encourage, and assist the development of the supply of raw materials within the Empire. On the other hand, it is suggested that Government control of industries should end as soon as possible after the war; also that labour must withdraw all restriction of output and hampering definitions of skilled work. It is clear that the Committee regards the statistics of trade available in this country as imperfect.

GENETICS AND EVOLUTION.

THE problems connected with genetics and "species-making" continue to attract the attention, both in the United Kingdom and in America, of many biologists, whose papers should not be neglected by students of heredity and evolution. In the *American Naturalist* for October last (vol. li., No. 610) Dr. R. R. Gates discusses the mutation theory and the species concept. With the help of many illustrative examples he tries to show that "there are two distinct types of variability having different geographical relations." The discontinuous type, "independent of environmental or functional influence, has given rise to many specific and generic characters, notably in plants, but also in higher animals." The continuous type "apparently represents the stress of the environment on the species in its dispersal," and "is notably exemplified in birds and mammals."

An exceptionally valuable study on variation in a group of mammals is furnished by A. C. and A. L. Hagedoorn, who write on "Rats and Evolution" in the *American Naturalist* for July, 1917 (vol. li., No. 607). These authors, who have worked from the economic and systematic point of view on "the rat population of the Dutch East Indies," contend that assemblages definable as "species" or "varieties" can be appreciated only through breeding experiments and field work, the results of which must constantly be invoked to check the descriptive activities of the museum specialist, who deals with dead skins and skulls. In their breeding experiments the authors found no new dominant characters, but "in every instance there appeared new recessive characters," for every one of which, they believe, "crossing, recombination of genes was the cause, not loss-mutation."

In connection with these questions, Prof. T. H. Morgan's discussion on the theory of the gene (*Amer. Nat.*, vol. li., No. 609) is noteworthy; in the course of his argument he refers to Prof. Jennings's important address summarised in NATURE of November 8 and 15, 1917. Prof. Morgan contends for the stability of the gene; if it vary, the variation falls around a mode. This question is further elucidated by Dr. R. Goldschmidt, who describes "Genetic Experiments concerning Evolution" (*Amer. Nat.*, vol. lii., No. 613), carried out on the gipsy moth (*Porthetria dispar*) and other species; from the crossing of races the caterpillars of which show varying amounts of dark pigment Dr. Goldschmidt concludes that the multiple allelomorphs for pigmentation "are different quantities of the substance which we call a gene, which act according to the mass-law of chemical reactions, *i.e.* produce a reaction or accelerate it to a velocity in proportion to their quantity." Insects from various European and Asiatic localities have been used in these experiments, and the author states that "the first step in the differentiation of species which occurs in Nature seems to be the formation of geographic races."

With this paper may be compared the second instalment of J. W. H. Harrison's "Studies in the Hybrid Bistoninæ" (*Journal of Genetics*, vol. vi., No. 4), in which details of the results of crossing several species of Poecilopsis with wingless females are given. Mr. Harrison lays stress on the importance of these results as affording evidence of the relationships between the species. Another paper on hybrid Lepidoptera worthy of attention is that by Mrs. Merritt Hawkes (*Journal of Genetics*, vol. vii., No. 2) on inheritance in the cross of two Saturniid moths, *Philosamia ricini* and *P. cynthia*, in which special attention is paid to larval characters, such as spots and tubercles; the appearance of abnormal larvæ with reduced tubercles (a recessive character) in the F_2 generation is especially interesting in relation to the existence of a few Saturniid species the larvæ of which are always without tubercles.

Among papers dealing particularly with problems of Mendelian analysis, R. K. Nabours and A. W. Bellamy's "Studies of Inheritance and Evolution in Orthoptera" (*Journal of Genetics*, vol. vii., No. 1) give a vast amount of detail of experimental work on grasshoppers of the Tettix group. The most important theoretical result is the apparent demonstration that while some patterns are allelomorphic to each of a number of others, a certain melanic pattern may be allelomorphic only to its absence. In connection with this subject attention must be directed to H. Terao's short but important paper on "Reversible Transformability of Allelomorphs" (*Amer. Nat.*, vol. li., No. 610), in which he describes cases of the occasional presence of a dominant character in the corresponding recessive homozygote in cultures of the rice plant. The frequency of this abnormal phenomenon is studied, and the author states that "the dominant and recessive types concerned are assumed to be transformed by certain unknown causes into the other allelomorph." He then proceeds to argue that on this view it is impossible to accept the theory that "the dominant allelomorph is due to the real presence of a hereditary material unit which is absent in the recessive allelomorph," and that the two "may be supposed to represent two alternative conditions or phases of a single hereditary substance, somewhat resembling the chemical conception of polymerisation."

In a controversial and stimulating "anti-vitalistic" discussion of biological enigmas, Dr. L. T. Troland (*Amer. Nat.*, vol. li., No. 606) carries the concepts of the chemist far more intimately into life-problems, and makes bold to write: "On the supposition that the actual Mendelian factors are enzymes nearly all . . . general difficulties instantly vanish, and I am not acquainted with any evidence which is inconsistent with this supposition."

The claims of some extreme "geneticists" that no discussions on evolutionary problems not founded on "experimental evidence" can be profitable are trenchantly dealt with by Dr. W. K. Gregory in an article entitled "Genetics *versus* Palæontology" (*Amer. Nat.*, vol. li., No. 610). To many who believe that much may still be done in the elucidation of phylogenetic problems on a large scale from the study of classification and morphology, Dr. Gregory's illustrations and arguments, drawn mainly from the wonderful series of American fossil mammals, furnish a bracing reminiscence of youthful days of controversy.

G. H. C.

THE FUTURE OF PURE AND APPLIED CHEMISTRY.[1]

FOR three years past pure chemical research has been dormant the whole world over, and it would be difficult for the most accomplished essayist to arrest your attention for an hour by an address on a subject of purely academic interest. Our mental point of view and our outlook upon both present and future are entirely different from those of four years ago; although the present is obscure and painful, the future gives promise of brilliant and rapid developments in natural science in general and in chemistry in particular. In this belief I venture to lay before you some reflections upon the growing recognition of the importance of our science and upon the responsibilities with which, owing to this change in public opinion, our shoulders are laden.

I have often heard the statement made by men who have grown old in the service of science that chemistry, and particularly applied organic chemistry, is a subject in which the British nation can never excel: that minute attention to detail, coupled with the power of organisation and co-operation, entails something antipathetic to the British character; the Germans, we know, have often expressed this view. The events of the last three years have sufficed to dissipate this fallacy for ever. The manner in which Great Britain, caught in the autumn of 1914 with scarcely any resources in the shape of equipment for the manufacture of fine organic chemicals, has rapidly become a larger producer of explosive, pharmaceutical, photographic, and other essential chemicals than Germany will remain an enigma to the historian of these present times. The obscurity which surrounds this rapidly executed operation is not diminished by the existence of difficulties which have naturally acted as inhibiting agents. This country enjoys in a greater measure than any other State a representative Government; in spite of the many advantages of such a form of Government, the fact remains that it necessarily admits of no representation of any phase of public opinion which is not loudly and insistently expressed. Science has always been in this latter position; it has been unvocative. During the first few years of the nineteenth century Dalton enunciated the atomic theory, Thomas Young stated the undulatory theory of light, and James Watt's steam engine came into general use. By these events all the amenities of human life have been revolutionised; indeed, they have exercised vastly more influence on the well-being of our race than did the Napoleonic wars. So accustomed are we, however, to routine habits of thought that most of us would probably answer, in reply to a suddenly posed question, that the battle of Trafalgar was the most pregnant event of the first quarter of the nineteenth century.

A brief moment of reflection would lead us to correct this hasty statement. Sodium was discovered by Davy in 1807, and benzene by Faraday in 1823. From sodium we obtain sodamide, the prime agent in making artificial indigo an economic possibility; the separation of benzene from coal-tar led by logical sequence to the production of Perkin's mauve and of thousands of other synthetic colouring matters, and to the manufacture from coal-tar anthracene of synthetic alizarin, the first heavy blow aimed at the position of the Turkish Empire, involving as it did the ruin of the Turkey-red or madder industry. The first practical process for making aluminium depended on the use of Davy's sodium, and with the aid of Davy's safety lamp 250,000,000 tons of coal are mined annually in this country with comparatively slight risk. Faraday's early investigations on the chemical aspects of electrolysis and his studies on magnetic induction led immediately to the invention of the dynamo, and, through Clerk Maxwell, to the introduction of wireless telegraphy; this one branch of Faraday's investigations, in point of fact, constitutes the ground-work of the whole stupendous vista of results of the general introduction of the electric current into modern life which is so familiar to us all. Cavendish's early pro-

[1] Abridged from the presidential address delivered at the annual general meeting of the Chemical Society on March 21 by Prof. W. J. Pope, F.R.S.

duction of nitric acid by the passage of an electric spark through air, reproduced on an enormously larger scale, is now furnishing Central Europe with the nitric acid without which no explosives could be manufactured.

The above-mentioned and multitudes of other fundamental discoveries in physical and chemical science were made almost within a stone's-throw of this room; most of them were made in the Royal Institution, and all of them by an expenditure of money infinitely small as compared with their present-day effects.

Anyone who is in the habit of reading modern historical writers—and they have become quite illuminating since a scientific mode of writing history has been substituted for the older fictional style—knows how political changes, national reforms arising from an effort of the collective conscience, the magnetic influence of some popular demagogue, and the like, are invariably invoked as explanatory of all the vicissitudes of our planet.

The modern historian is here taking a false point of view, and since he is, in general, quite unacquainted with physical science, his methods are inadequate. The whole history of Europe for the last century has been made within a few hundred yards of Burlington House in our scientific laboratories. One of the most potent incentives to political changes resides in the desire to increase the amenities of life, and research in pure science has had for a hundred years past the greatest influence in facilitating the realisation of that desire. Co-operative effort, one of the most striking aspects of modern life, became possible only when science provided the facilities for municipal power schemes, for telegraphic connection over the whole world, and for the concentration of production in definite centres. Chemical science is still furnishing the means for further revolutionary changes; during the last few years we have seen great technical developments of purely scientific discoveries—the work of Dewar on the liquefaction of gases, and that of Cross and Bevan on viscose and artificial silk, both of which have led to the profitable utilisation of vast amounts of capital—and it is as yet impossible to indicate the ameliorations of the conditions of human life which will inevitably result from contemporary chemical investigation.

In a time of crisis like the present, British custom tends towards the replacement of unreal conventions by what is really vital; we have been engaged upon this operation for several years. Whilst previously unheard-of changes have succeeded each other kaleidoscopically in the national constitution, in the political parties in power, in the freedom of the subject, and in hosts of other ways, the nation has recognised that science is the only real maker of history. The whole Empire is now one vast chemical and engineering laboratory, and we even live on a scientific ration of so many calorific units. It is obvious that chemistry, with physics, engineering, preventive medicine, and others of the natural sciences, which previously had no imperialistic position, because powerless to make or break a Government, have become the pivot on which turn all our hopes of retaining an independent national existence; it has been suddenly realised that supremacy in these branches of knowledge is vital to our country.

The time is approaching when this state of affairs will change; neglect of the natural sciences will then no longer put us in danger of sudden extinction, but, as was taking place years ago, will lead to our slow, certain downfall as a nation. The responsibility is placed upon our men of science of taking such measures as will ensure that the old order is not re-established, that Science makes her voice heard in our national councils, and that policies of drift are for ever abandoned.

We have in this country three large and long-established organisations devoted to various phases of chemical science: the Chemical Society, the Society of Chemical Industry, and the Institute of Chemistry. Is it too much to ask that these three representative bodies, with perhaps the newly founded Association of British Chemical Manufacturers, and ultimately all the other cognate but more specialised interests, should set up a watchful and alert joint council with directions to consider national questions in which any of the varied interests of chemistry are concerned, and to make such representations to our administrators as would voice the corporate view of the joint body?

I am inclined to think that, had such a body been in existence several years ago, much that has been accomplished in the interval by somewhat devious methods would have been better done. One instance will occur to everyone: that of the much-debated question of the re-establishment of the coal-tar colour industry in Great Britain. The scheme adopted by the Government for resuscitating this industry in our country, after its past thirty years of profligate productivity on the Continent, was launched without scientific advice; the Cabinet mouthpiece, indeed, declared that the directorate of the company was not to include men of scientific knowledge, on the ground that a director who knew something about the business of the company would have an advantage over his less well-informed colleagues.

Owing largely to the fact that we possess no strong collective council, representing the combined academic, scientific, and industrial aspects of our science and capable of representing them before a representative Government, it may be argued that we chemists are not altogether blameless for the particularly blundering way in which particular errors have been perpetrated by the responsible officials. Whilst we should be thankful that our blunders have not led to our destruction, we should proceed without further delay so to organise the resources of chemistry as to make it possible to enforce the adoption of scientific methods and modes of thought by authorities to whom these are yet strange.

The serious character of the British position in connection with the coal-tar colour industry becomes more evident when one considers that this is a key industry; upon it depend the textile, paper, photographic, and pharmaceutical industries. The total capital employed in the organic dye industry in Great Britain is between four and five million pounds, whilst the capitalisation of the German coal-tar colour firms is of the order of fifty million pounds. The need for greater and more intelligent activity in this direction is obvious; unless national enterprise can be stimulated into providing adequately for the manifold requirements of Great Britain and her Colonies in all those industries which depend on coal-tar colour manufacture, we shall be again in the hands of the foreign producer.

The control of a national dye scheme by business men with no real feeling for the enterprise on which they are engaged renders it fairly certain that the wider aspects of coal-tar colour manufacture will be neglected. The interweaving of the colour interests with those of synthetic pharmaceutical, photographic, and other chemical industries is essential to success. The utilisation and development of the resources of the Empire in natural colouring matters such as indigo are necessary from a national point of view. The careful study of our own and other codes of Patent Law in their bearings upon the fine chemical industry is also important. These weighty questions cannot receive adequate consideration from any purely lay body.

It is mournful, but instructive, to compare our present position in the coal-tar colour industry with the prospects which that branch of applied chemistry exhibited to Great Britain in early days. The first coal-tar colour was made by Perkin in 1856, and in 1862 Prof. A. W. von Hofmann, one of the foremost chemists of the day, a German domiciled in this country, painted an alluring picture of the future in store for us. Said he:—"England will, beyond question, at no distant day, become herself the greatest colour-producing country in the world—nay, by the strangest of revolutions, she may, ere long, send her coal-derived blues to indigo-growing India, her tar-distilled crimsons to cochineal-producing Mexico, etc." When we contrast this dazzling prospect, made by one of the most far-sighted of contemporary German chemists, with the actual situation, we cannot but ask why the event fell so miserably behind the forecast. The reason, in my opinion, lies in the fact that opulent, indolent Great Britain has for the past century permitted all its educational interests to pass into the hands of a particular caste which despises all knowledge difficult to attain, and, to camouflage its own idleness, has always pressed the notion that a first-hand knowledge of the facts of natural science and the conclusions to be drawn therefrom is unimportant, and that the young man or young woman does his or her best in the world if thrown into it entirely destitute of anything but an evanescent acquaintance with certain classics and a decided taste for so-called learned leisure. The greater among the ancients were creators of new knowledge as well as masters of the whole accumulated world's stock of information; their successors, unproductive of positive knowledge and very ignorant of the great changes taking place around them, can but wonder at and comment vaguely on the genius of Archimedes and Aristotle, and necessarily despise the achievements of Newton and Kelvin, their modern prototypes.

I have already directed attention to the frequently expressed opinion that, as a nation, we are incapable of excelling in the fine organic chemical industry; let me quote one instance, small in itself, but large in its consequences, in disproof of this view.

The ordinary photographic plate is sensitive only to a region in the blue of the spectrum, but by incorporating certain rather fugitive organic dyes with the sensitive film, the latter may be rendered sensitive to the green, yellow, and red parts of the spectrum; photographic plates so treated are described as panchromatic. The quantities of the sensitising dyes required for the whole world's consumption in normal times is minute, being, indeed, of the order of a few pounds per annum. Until 1915 these substances had never been made outside Central Europe, and little was known by us of their compositions or of the methods of preparing them, as they were all sold under trade names. The manufacture of these materials, small as was the whole business, had been industriously cultivated by the German colour-works, and, as these colour sensitisers are essential in aerial photography, their scarcity became of serious import quite early in the war.

The experimental investigation of the whole subject was quickly put in hand in this country, and within a few months ample supplies of the usual sensitisers were produced. Further, the newly established Department of Scientific and Industrial Research financed the development of the study of photographic sensitisers; as a result of this action, new sensitising dyes have been produced which are far superior to the older ones. It is safe to assert that the manufacture of panchromatic plates has now attained a degree of perfection in this country such as will long defy competition.

This is but one case that may be quoted from among a host of others, all of which prove conclusively that, given a little encouragement and assistance, British chemistry is capable not only of giving much-needed relief in this time of strain, but also of meeting every demand which can be made on it when the period of reconstruction commences.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Dr. G. N. Watson has been appointed to the chair of mathematics, which is being vacated by Dr. R. S. Heath at the close of the current session.

At a degree congregation held on July 6 the degree of M.Sc. was conferred on the following candidates:—Ernest Coupland, Junquei Su-Kwang Lee, William John Owen, Jui Hui Teng, Sih Ling Ting, and Nai Yone.

IN the latest instalment of the 1916 series of "The *Athenaeum* Subject Index to Periodicals," issued at the request of the Council of the Library Association, the subjects of education and child-welfare are dealt with. Among the periodicals the articles of which are indexed we notice NATURE, the *Times Educational Supplement*, the *School World*, and the *Journal of Education*. This issue of the "Index" makes a special appeal to all persons interested in educational questions; its price is 1*s*. net, and copies may be obtained from the *Athenaeum*, Bream's Buildings, Chancery Lane, E.C.4.

THE Secretary of State for the Royal Air Force announces that the sum of 25,000*l*. has been placed at the disposal of the Government by Sir Basil Zaharoff, G.B.E., for the purpose of endowing a professorship of aviation. This munificent donation is in continuation of donations previously made by Sir Basil Zaharoff for the foundation of chairs of aviation at the Universities of Paris and Petrograd, in order to assist in the progress of aviation among the Allies, and it is his hope that the occupants of the chairs will continuously exchange views. It is proposed that the professorship shall be called the Zaharoff professorship of aviation, and that it shall be a chair of the University of London attached to the Imperial College of Science and Technology.

Scientia for March last contains an interesting paper on "Le Nouvel Humanisme," by Prof. George Sarton, of Harvard University, U.S.A., who points out that the war has shown that science must be given a much more important place in schools and colleges than it has hitherto occupied. In the past, systems of education have been drawn up by classical scholars, who have considered that the study of languages, history, and literature is more likely to train youths to become good citizens than the study of science. Prof. Sarton holds that teachers of science are partly responsible for this opinion. Too often has science been taught as a jumble of isolated facts and theories. Prof. Sarton proposes to introduce, as a reform, instruction upon the history of the development of science in all countries from the earliest time. The more important facts and theories of science would be unfolded to the student in the historical order of actual discovery. He would then find that advances were due not so much to some transcendent genius as to the general state of human knowledge when they were made. The next step forward being fairly obvious, any intelligent and well-educated man might have made the advance. It is believed that instruction on these lines could not fail to stir the minds of the learners to fruitful activity. Prof. Sarton would have history taught as a story not of the vicissitudes of kings and their wars, but of the growth and organisation of positive knowledge and of its application to the material advancement of the peoples. Such descriptions would be completed by the history of civilisation, including law, religion, fine arts, social economy, and politics. History taught in this way is called "the new humanities." To supply teachers it is proposed to found in the United States an institute for the history of science and civilisation. An account of the proposed institute will be found in *Science* for March 23 and October 26, 1917.

SOCIETIES AND ACADEMIES.

LONDON.

Challenger Society, June 26.—Dr. G. H. Fowler in the chair.—S. F. **Harmer**: Whaling in the Far South. The species hunted and the methods of capture were described; attention was directed to the large numbers killed annually and to the necessity for protective measures; statistical evidence was given to show that the fin whale, the blue whale, and the humpback have definite breeding periods.

PARIS.

Academy of Sciences, June 24.—M. Léon Guignard in the chair.—A. **Lacroix**: The constitution of a salt from plants grown in the Cameroons. The salt is extracted by the natives from the ashes of a plant, probably *Panicum crus Galli.* It is rich in potash salts, containing 83·5 per cent. of potassium chloride, 7·1 per cent. of calcium potassium sulphate (syngenite), 3·9 per cent. of potassium sulphate, with some common salt, magnesium chloride, and silica. The absence of carbonates is remarkable.—J. **Boussinesq**: General equations governing the slow flow of semi-fluid materials, either plastic or pulverulent.—G. **Bigourdan**: The observatories at Paris known as "de la rue des Postes." There were two early observatories bearing this name, which are sometimes confused: that of Picard (1673), and that of Godin, de Fouchy, and Bouguer (1731). The positions of these two observatories are deduced from data in various documents.—C. **Richet**: General anæsthesia by chloralose in cases of traumatic shock and hæmorrhage. The advantages and inconveniences of chloralose as an anæsthetic are summarised. The main advantage is the absence of toxic action on the heart, as there is no lowering of the arterial pressure.—P. **Sabatier** and G. **Gaudion**: The decomposition of glycerol in presence of various catalysts: the formation of ethyl and allyl alcohols. The catalysts studied were alumina, copper powder, and uranous oxide. Alumina gave carbon monoxide, methane, acrolein, and higher aldehydes. With copper the gases evolved contained a high proportion of hydrogen; the liquid products included ethyl and allyl alcohols, propaldehyde and other aldehydes.—M. **Balland**: Bread-making from wheat without previous grinding. An account of various attempts from 1789 to 1916 to make bread from unground wheat. No satisfactory bread has hitherto been made by this method.—J. **Bosler**: The spectrum of the new star in Aquila.—F. de **Roy**: Discovery and observations of Nova Aquilæ.—P. **Brück** and P. **Chofardet**: Observations of the new star.—J. A. **Le Bel**: Catathermic phenomena at 1000° C.—M. **Guerbet**: Bornylenecamphor and a new dicamphor isodicamphor. By the action of sodium methylate upon camphor at temperatures between 100° C. and 180° C., the main product of the reaction is a new isodicamphor, $C_{20}H_{30}O_2$; a small quantity of bornylenecamphor is also obtained.—J. **Amar**: Psychographic observations.—H. **Bierry** and P. **Portier**: The action of symbiotes upon the constituents of fats. It is shown that symbiotes can convert glycerol into dioxyacetone, β-oxybutyric acid into acetone and acetaldehyde, and butyric acid into acetone.—A. **Gauducheau**: Food preparations from blood and meat by the aid of yeast.—MM. **Folley** and **Leprat**: The blood in exophthalmic goitre. The white and red blood corpuscles in this disease are normal as regards number and shape.

BOOKS RECEIVED.

Rural Water Supplies and their Purification. By Dr. A. C. Houston. Pp. xv+136. (London: John Bale, Ltd.) 7s. 6d. net.

A Complete Course of Volumetric Analysis for Middle and Higher Forms of Schools. By W. T. Boone. Pp. viii+164. (London: Blackie and Son, Ltd.) 3s. 6d. net.

A Memoir on British Resources of Sands and Rocks used in Glass-making, with Notes on Certain Crushed Rocks and Refractory Materials. By Prof. P. G. H. Boswell. With Chemical Analysis by Dr. H. F. Harwood and A. A. Eldridge. Second edition complete in one volume. Pp. xi+183. (London: Longmans and Co.)

High Explosives. By Capt. E. de W. S. Colver. Pp. xxix+830. (London: Crosby Lockwood and Son.) 3l. 3s. net.

56th Annual Report of the Secretary of the State Board of Agriculture of the State of Michigan, and 30th Annual Report of the Experiment Station. Pp. 749. (Lansing, Mich.)

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, JULY 18, 1918.

MALARIA AND ITS TREATMENT.

(1) *Malaria in Macedonia: Clinical and Haematological Features and Principles of Treatment.* By P. Armand-Delille and others. Preface by Prof. Laveran. Translated by Dr. J. D. Rolleston. Edited, with a preface, by Sir Ronald Ross. Pp. xxx+115. (London: University of London Press, Ltd., 1918.) Price 6*s.* net.

(2) *Anti-Malaria Work in Macedonia among British Troops.* By Dr. W. G. Willoughby and L. Cassidy. Pp. x+68. (London: H. K. Lewis and Co., Ltd., 1918.) Price 4*s.* 6*d.* net.

(1) THIS work deals with the parasitology of malaria, the associated clinical manifestations and the treatment, the main and more important part being the clinical. In the section on parasitology the authors enlarge on the importance of parthenogenesis of the gametes as the cause of the persistence of the infection and of the relapses. As J. D. Thomson has pointed out, the so-called parthenogenesis of the malarial parasite is based on a misconception of Schaudinn's of what the term "parthenogenesis" is, and on an error in interpreting the facts observed by him.

The greater prevalence of subtertian infections during the summer, and of benign tertian during the autumn and winter months, is in accordance with the findings of British workers on the Struma and Doiran fronts, and seems to bear some relation to the seasonal preponderance of different species of anophelines.

As stated, the chief portion of the work is devoted to the clinical aspects of the disease. Judging from the number of symptoms and complications described, it would appear that a considerable amount of work has been devoted to these points. Unfortunately, the authors give us no information of the number of malaria cases observed by them, or of the number of cases of the various clinical types they describe. They divide malaria clinically into two categories, primary and secondary paludism, with an intervening apyrexial period associated with relapse and complications.

Primary paludism may manifest itself as a slight febrile attack, or as a febrile gastric derangement, and it may also simulate typhoid, paratyphoid, or what is designated "Mediterranean dengue." Associated with this stage may be anæmia, varying in severity from a barely perceptible pallor to pronounced anæmia, with wasting and jaundice, and, perhaps, complicated with œdema or hæmorrhages, especially epistaxis, which is described as being fairly common. Petichiæ have also been observed. Whereas hæmorrhagic symptoms improved under quinine administration, œdema seemed to be unaffected by the drug.

A great number of symptoms and complications are described as being associated with primary paludism. These are arranged in order according to the organs involved. A condition called "infective icterus," bearing a close resemblance to Weil's disease, but being less fatal than the latter, is described. "Suprarenal insufficiency" appears to have been encountered several times. Acute cachexia was found only in connection with subtertian infections. Albuminuria was present only in a few cases; a definite acute nephritis was rarely seen. Although a few patients developed "hæmoglobinuric fever" early in the disease, this condition generally became manifest during the course of secondary paludism.

The authors state that they have not observed a true amaurosis in connection with malaria or its treatment with quinine; they consider the condition so exceptional as to be no contra-indication to treatment with large doses of quinine. They are also sceptical as to quinine deafness, but they have noted disturbance of the equilibrium, with excitability of the vestibular nerve, in two cases.

Pernicious attacks of malaria are attributed to invasion by large numbers of parasites in individuals whose resistance is diminished. They were met with only in *Plasmodium falciparum* infections, and generally in men suffering from great fatigue following overwork. The term "defaced paludism" is given to various atypical forms of malaria. "Masked paludism" includes cases in which the visceral manifestations are unaccompanied by febrile phenomena.

Secondary paludism, characterised by "disciplined" attacks, occurs in patients not exposed to reinfection by mosquito bites, and is that clinical form met with in cases which have returned to non-malarial countries. Under this heading are described all the ague attacks and their associated clinical phenomena. A short account of hæmoglobinuric fever is given.

The diseases most commonly found complicating malaria were typhoid, dysentery, and "recurrent fever." For the treatment of paludism, quinine hydrochloride is recommended as the most efficient salt. It should be given in 3-gram doses, and may be combined with urethane or antipyrin. The best method of administration, according to the authors, is by intramuscular or subcutaneous injection. Oral quinine is rarely considered advisable owing to the gastric disturbances generally present. Intravenous quinine should be given only as an extreme measure and where there are suitable conditions, as in large hospitals. The drug should be given daily during the febrile attack, six to eight hours before the attack is expected. In mild relapses 2-gram doses are advised, and in bad relapses 3-gram doses. In pernicious attacks great reliance is placed on adrenalin—2 milligrams in 500 to 1000 normal saline. Quinine in relapsing cases should be suspended between the attacks. During treatment absolute rest in bed, substantial diet, and the administration of iron and arsenic are recommended. The authors do not say how long quinine should be continued after the last febrile attack.

The impression left on the reader by this work is one of some confusion, but possibly this may be partly due to the difficulties of translating technical scientific points. Such expressions as "infective icterus," primary and secondary paludism, the frequent repetition of imposing words like "syndrome," the mistake about the parthenogenicity, do not tend to lucidity.

One good result of studying this book may be to impress medical men with the necessity for suspecting malaria either as cause or as complication in all cases of disease, no matter what, occurring in intensely endemic districts or in patients returning from such.

In his preface Prof. Laveran criticises some points in the treatment of malaria. Many of the points mentioned above are dealt with in greater detail in a preface which Sir Ronald Ross has contributed to the English edition.

(2) The purpose of this little book, as explained in the preface, is to help future workers in anti-malarial measures by an account of the author's own experiences in Macedonia. In the first chapter the three parasites causing malaria are mentioned, and a brief account is given of the anopheles prevalent in Macedonia and acting there as hosts for the extra-corporeal phase of the plasmodium. A review of the prevalence of the disease according to the weekly notifications follows. The incidence appears to be at its lowest in January, after which it rises gradually until the latter part of May, when a slight remission takes place until the end of June; a rapid rise then occurs, and the elevation continues until the third week of July. A decline again takes place for a short time, followed by another rise, which reaches its maximum at the end of October. It is gratifying to read that there has been a decrease in the number of cases reported in 1917 as compared with 1916, although it is pointed out that owing to the continuance of relapses and carriers from the latter year it is difficult to guarantee the accuracy of the figures.

Malaria in Macedonia has been responsible for a much higher degree of invaliding than wounds have. The infection is so widespread that even units at the base and on the lines of communication are liable to the disease. The difficulty in dealing with the breeding-grounds of anopheles in "No Man's Land" at the front is responsible for the greater prevalence of malaria amongst the troops in that area.

The description of the topography of the country, with its swamps, rivers, streams, and wells, and the deserted villages, together with the account of the inhabitants, who seem to be almost universally infected with the parasite, renders obvious the magnitude of the task with which the medical authorities are faced. An outline of the general system observed by them in dealing with the problem shows that the measures adopted are both systematic and thorough.

The various means of combating the disease are described in detail. They are too numerous even for enumeration in a short review, but officers engaged in anti-malarial work will find a perusal of this section of valuable assistance. Stress is laid on the necessity for destruction of adult anophelines, which is regarded as being of even more importance than efforts to suppress the breeding-places of the insect.

The methods in use for protecting men from mosquito attack are carefully described, and the mechanism of using and keeping the new and improved mosquito-proof bivouacs and tents is given at length. The importance of educating officers and men in anti-malarial measures is strongly advised. Routine gas-mask drills are carried out, and the authors insist that if this is necessary, then anti-mosquito training is much more so on account of the very much higher percentage of invaliding from malaria.

The authors are guarded on the subject of quinine prophylaxis, but, on the whole, one infers that the administration of quinine (in the doses usually given as a prophylactic) has not been attended with success in the Salonika area. Prophylactic quinine, however, is not believed by them to interfere with the curative value of the drug if given afterwards.

The contents of the book are summed up in the last chapter, and many suggestions are made for the future, including propaganda amongst officers and men by posters and pamphlets as in use amongst our French Allies. Closer co-operation between executive and medical officers and the more rigid enforcement of precautions already ordered are advised.

The whole book provides very interesting reading, and it should be of valuable assistance to combatant officers and laymen as well as to medical officers. It contains evidence of the endurance and courage of our troops in a most difficult country under very trying conditions, and it shows the skill and determination with which the R.A.M.C. is endeavouring to combat a big problem.

F. W. O'CONNOR.

FRENCH WORKS ON RADIOGRAPHY.

(1) *Localisation et Extraction des Projectiles.* Par L. Ombrédanne et R. Ledoux-Leband. Second edition. Pp. iv + 305. (Paris: Masson et Cie, 1918.) Price 4 francs.

(2) *Précis de Radiodiagnostic Technique et Clinique.* Par Dr. Jaugeas. Préface de Dr. Béilère. Second edition. Pp. xxviii + 563. (Paris: Masson et Cie, 1918.) Price 20 francs.

(1) IN this excellent volume—one of the "Collection de Précis de Médecine et de Chirurgie de Guerre"—the authors set forth the most recent methods employed in the localisation and extraction of foreign bodies. The appearance of a second edition so soon after the first is testimony to the need for such information on the part of the medical profession and also to the high value which the work has attained since its appearance. The appreciation of the work of our Allies in all fields connected with the war is always a pleasure to workers in this country. The estimation in which this book is held is evidenced by the recent appearance of the first volume translated into English. We hope the editor of the first English

edition will soon be engaged on a translation of the second.

In no sphere of war work have our French Allies done better than in that for the relief of suffering caused in the war. The volume before us gives ample evidence of the advances that have been made in surgery and its essential accompaniment, radiography. The fact that the surgeon and the radiographer must work hand in hand is demonstrated in a perusal of the pages of the book.

The letterpress is extremely clear, the descriptions of apparatus and methods being very lucid. The illustrations amply figure the conditions referred to in the text; several are of particular interest, notably two plates of the thorax showing a bullet in the heart. The particular interest lies in the rapidity of the exposure, which must have been instantaneous, if one can judge from the extreme sharpness of the pictures. The value of radiograms of this quality is self-evident.

The subject is dealt with widely from all points of view, particularly from the surgical, and all, or practically all, methods of localisation are described. The description of the principles underlying the practice of localisation is very clear, and cannot fail to be instructive and helpful to all.

The useful methods of localisation are well dealt with, and attention must be directed to the combined method which is referred to as "extraction à l'aide de contrôle intermittent." The method so named is carefully described and must be of great value to surgeons at the present time. Surgeons and radiographers are recommended to read these chapters carefully, particularly those dealing with the dangers accompanying the method.

An interesting feature of the book is the description of radioscopic stereoscopy, which has been perfected in France by Dr. Lièvre. This is a most important advance in technique, and if the method is accurate and protective measures are assured, it should enable the operator to remove foreign bodies under screen observation in the minimum time, thus saving his time and ensuring the safety of the radiologist, who may have to do screening for a large number of operations.

(2) The title of this book admirably covers the full subject-matter of the volume, which is an excellent précis of the technical and clinical side of radiography. An interesting historical *résumé* of the discovery of the X-rays, and the subsequent development of the technique resulting from their use in medicine, forms the opening chapter of the work. Instrumentation is well described, and detailed descriptions are given of the most important pieces of apparatus. We note with approval a good description of the Coolidge tube. The question of protection against the injurious effects of X-rays is entered into fully. There is an excellent discourse on the physics of radiography—the physical facts underlying the use of the rays are fully considered. It will well repay the advanced radiologist to read these chapters carefully.

The chapter dealing with "application à l'homme normal" is particularly good. It deals successively with the technique of examination of the normal parts, and gives good descriptions of the composition of each picture. The whole is a very complete account of what the radiographer must be familiar with before he proceeds to an investigation of the abnormal.

The third section of the work deals exhaustively with "le radiodiagnostic en clinique." Many valuable plates illustrate this section, which will prove to be a most useful guide to the many workers in radiography at the present time.

Radioscopy is dealt with thoroughly.

The almost strict adhesion to French types of apparatus will strike the British reader forcibly. It would have been a useful addition to the value of the book if a number of American and British models had been described; but this is almost exclusively a French book, and from a perusal of its pages readers here will be able to understand what our Allies are doing in this important branch of science, and to appraise the value of their war effort in the field of radiography.

Naturally, at the present time our energy on both sides of the Channel is devoted to the discovery of the damage done by projectiles, their localisation and removal from the body, and the diagnosis and treatment of injuries to bone and the vital organs. It is with pleasure that we recognise that our French confrères are in this, as in all other branches of medicine, occupying a position which is worthy of their great past and promises a still greater future.

Normal radiography is gone into fully, and a number of good plates illustrate this section. Various abnormalities are described. The diagnosis of gastro-intestinal diseases, diseases of the thorax and of the urinary system, and the diseases and injuries of bones receive adequate description.

The book, as a whole, is a good one, and can confidently be recommended to British readers as a first-class production and a trustworthy guide to the practitioner and specialist—embodying in its pages the best work of a distinguished French radiologist.

THE EDUCATION OF ENGINEERS.

The Education of Engineers. By H. G. Taylor. Pp. vii+64. (London: G. Bell and Sons, Ltd., 1917.) Price 2*s.* net.

THE author of this little book endeavours to maintain the thesis that engineering is an art and not a science, and that since mechanical arts cannot be taught at a university, courses in engineering in universities are, in consequence, futile, and fail to contribute to the training of an engineer. This point of view is not novel, but it is surprising to find it supported by a university lecturer in civil and mechanical engineering.

The author's criticisms of university engineering training revolve around its academic character and lack of relation with practice. While, in a large measure, this view is correct, it is not necessary to return to the primitive methods of training engineers in order to find a remedy. Such methods, in which knowledge was acquired by experience, were admirably suited to the days when engineering practice was largely empirical. To-day, however, a lengthy period of technical training is essential, but it should preferably be preceded by at least one year in the works, and followed by a two or three years' apprenticeship. Technical training will never make indifferent students into good engineers, and able students may succeed without it, but the average man finds it a necessity. The remark that a man must first be an engineer by nature applies equally effectively to all walks of life.

The author's gravest error, however, is the inexcusable manner in which the requirements for and characteristics of engineers and artisans and of engineers and inventors are confused. Industry has long since lost that individual craftsmanship which distinguishes art; and the parallel drawn between artists and engineers no longer holds good. In the case of dentists—to which special reference is made—the field of work is so broad that a distinction is now being made between the dental mechanic, who learns his trade much as does the engineering artisan, and the dentist proper, who is frequently university-trained, as is the engineer. Clearly, the author has not fully comprehended the difference now existing between trade education and technical education for manual workers and for professional engineers respectively.

The book is written in a very attractive manner, although it is marred by several examples of slipshod phraseology. We are unable to see in it any adequate result for the four years' research admitted by the author, or the call which prompted him to write it.

OUR BOOKSHELF.

Field Book of Insects. By Dr. F. E. Lutz. Pp. ix + 509. (New York and London: G. P. Putnam's Sons, 1918.) Price 12s. 6d. net.

THE author of this handy little volume offers something of an apology for adding to the large number of books—"popular, semi-popular, and unpopular"—on insects, but he has produced a general guide to entomology which will prove uniquely valuable to the amateur collector and observer. "I have been governed in the choice of subject-matter," he writes, "not so much by what I think ought to be in a book on insects as by what the public seems to want to know." He gives summarised characters for the discrimination of the various insectan orders, diagnostic tables for the principal families, and in some cases also for the genera, and mentions a number of species—1400 in all—which may be found commonly in the northern United States, naturally paying especial attention to those of economic importance. On the hundred small plates—many of which are effectively coloured—a good selection of these species is clearly figured. The result is that the student can scarcely fail to identify, approximately at least, the insects which he captures during an ordinary country ramble, while he finds in this volume (which would slip easily into a side-pocket) interesting information about their habits and importance.

Although the book deals specially with the North American fauna, it will prove of service to British and European collectors, as so many of the species and nearly all the genera are common to the Eastern and Western continental lands. Nevertheless, a work somewhat on these lines, compiled for the benefit of our own people, would be a most desirable addition to our entomological literature, for it certainly contains "what the public seems to want to know," and "the public" that is mildly interested in entomology has a particular desire for coloured figures which render comparatively easy the identification of conspicuous insects, like the popular Lepidoptera, to which Dr. Lutz devotes more than 100 pages. A special chapter on galls, with four plates of outline drawings, furnishes an introduction to a highly interesting aspect of insect bionomics. G. H. C.

The Grapsoid Crabs of America. By Mary J. Rathbun. (Smithsonian Institution, U.S. National Museum, Bulletin 97.) Pp. xxii + 461. (Washington: Government Printing Office, 1917.)

THIS volume, by an author who has earned a high reputation by previous work on Decapod Crustaceans, is part of a systematic treatise dealing with the crabs of the whole of the New World, to be completed in four parts, the main purpose being to give a brief description, with figures, of each species, together with a detailed catalogue of the specimens in the United States National Museum.

The work has evidently been prepared with great care. When the author took up the subject the collection under her charge had been partly worked out, but the nomenclature stood in need of revision, and in order to overcome the difficulties connected with a correct interpretation of the types of so many species described by Fabricius, Herbst, de Saussure, the two Milne Edwards, Miers, and others, she spent much time in the museums of Copenhagen, Kiel, Berlin, Geneva, Paris, and London, where not only fresh descriptions and photographs were taken, but arrangements were made for exchanges whereby many co-types and specimens directly compared with types were secured for the American museum.

The classification adopted is that of Borradaile for the higher groups; the definitions of families and sub-families are copied or adapted from those given by Alcock.

Illustrations add greatly to the value of a work of this kind; the numerous text figures and 161 plates, on which examples of nearly all the species dealt with are represented from photographs, deserve the highest praise.

Now that such an excellent guide is available, it is to be hoped that attention will be directed to the life-histories, which, the author tells us, have not been worked out in more than a dozen American species. G. A. B.

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.*]

Weeping Forms of Trees.

IN NATURE for July 11, on "Weeping Forms of Elm," Mr. W. H. Shrubsole refers to two distinct factors: (1) the "weeping" of the shoots, and (2) the peculiar contorted appearance of the older branch-systems. A fine specimen of the weeping ash, grafted, as usual, standard high on a common ash stock, in the Oxford Botanic Garden, shows a clear "umbrella" of weeping branches, while the head of the tree is a similarly twisted and contorted mass of large boughs.

The weeping effect is due to weak geotropic sensitivity, but to a greater extent to congenital enfeebled response to the action of light. The weeping shoots on bending branches grow out in the direction impressed on them in the bud, without any attempt at correction, and thus pass out and down, almost vertically, as sub-etiolated shoots with very long internodes (a foot or more), the shoot of the current year being as much as 6 ft. long. It is obvious that they cannot go on for ever, as they soon touch the ground, while they receive the less illumination as they pass down from the crown of the tree.

But not all the branches are of this type, as in other freak-forms the normal type of strongly positively heliotropic shoot with erect habit and short internodes (6 in.) is still freely produced. Since these get into the more illuminated regions they progress, after all, better than the others; and as they twist round on the drooping branches to straighten up, the surviving branches of the tree ultimately consist only of such "contorted" shoots, and the central trunk-system takes on the peculiarly twisted mass of boughs.

The effect is, however, only an exaggerated expression of the same causes which produce the erecting curvatures in a tree formed of branch-systems bending down under the weight of their foliage; and all weeping trees tend to show it more or less, the weeping ash, with decussate foliage and long annual shoots, perhaps most clearly. To make a more shapely "umbrella," the non-weeping shoots may be cut out, but the tree continues the space-form by "natural causes." A. H. CHURCH.

Botanical Laboratory, Oxford, July 15.

The Mineral Wealth of Germany.

IN NATURE of July 4 Prof. Louis criticises my paper, "Germany's Natural Wealth," which appeared in the *Fortnightly Review* of June. In that paper I pointed out that the wealth of Germany in coal, iron-ore, and potash amounts to at least 240,000,000,000*l*., taking the value of coal and of potash at 10*s*. per ton and that of iron-ore at 5*s*. per ton. Prof. Louis, on the other hand, tries to show that the value of Germany's three principal minerals comes only to 700,000,000*l*., and asserts that I have overstated Germany's mineral wealth more than three hundred times.

With all respect to the scientific eminence of Prof. Louis, I am afraid that he has made a great mistake. The value of a nation's natural resources can be estimated either from the point of view of the capitalist, who wishes to exploit mines, etc., for his personal profit, or from that of the nation as a whole. A nation has two characteristics. In the first place, it must be considered practically immortal. In the second place, it consists not merely of a few capitalists, but of the whole population. From the point of view of the company promoter, the capitalist, or the shareholder the value of a ton of coal *in situ* is, of course, not 10*s*., but only a few pence which form the capitalist's margin of profit, provided the coal be immediately available, and merely a small fraction of a penny if it be available fifty years hence. Every child knows that. On the other hand, from the point of view of an undying nation the value of a ton of coal *in situ* is, of course, 10*s*., or whatever is a fair average price at the pit's mouth; for although 9*s*. 6*d*. may be required in wages and expenses to extract that ton of coal, this 9*s*. 6*d*. goes to the nation. Therefore a ton of commercially exploitable coal *in situ* is worth 10*s*. from the national point of view, whether it will be extracted in the present year or a century hence. The same reasoning applies, of course, to iron-ore and potash.

My article dealt exclusively with Germany's national wealth from the national point of view. I did not even mention the profit of capital, which is a minor consideration. While Prof. Louis's estimate capitalises and sums up the immediate value of the profits of capital, my estimate of the value of Germany's mineral resources is taken from the point of view of the nation. Of course, it is absolutely non-permissible to say, as Prof. Louis does, that the value of a ton of coal is 6*d*. because that is the capitalist's profit. If coal-mining in Great Britain would return only sufficient to pay expenses, cost of management, etc., the British coalfields, the basis of the country's wealth, would, according to Prof. Louis, be worth exactly nothing, while by my calculation they would be worth 100,000,000,000*l*.

In view of the probable increase in the price of coal, iron-ore, and potash in the future, my estimate of the value of Germany's minerals was probably a great understatement. POLITICUS.

July 6.

THE above comments of "Politicus" are marred by two notable fallacies. In the first place, he holds that my valuation of the minerals is based upon the profit to be derived from mining them. This is quite wrong; my valuation of the coal, etc., *in situ* is based upon the only true criterion of value, namely, the price which it will fetch in the ordinary open market, the sum which those who wish to mine the coal are prepared to pay for that coal in its unsevered condition, *i.e.* in this country the average royalty which the coalowner can get for it. The profit which those who mine it can make out of it has nothing whatever to do with the valuation, except indirectly, in the sense that coal which cannot be mined at a profit is unsaleable, and therefore has no value. The other fallacy is, perhaps, best shown by pointing out that, according to "Politicus," the unsevered coal in the bowels of the earth is worth as much as the same coal at bank, so that in his view the nation gets the labour and materials expended on raising the coal for nothing! It is surely obvious that if coal at bank, after 9*s*. 6*d*. per ton has been spent upon getting it, is worth 10*s*. per ton, it cannot be worth 10*s*. before anything has been spent upon it, and that this is equally true whether such expenditure be looked upon as national or as individual.

The further contention that money realisable in fifty years is worth as much as money realisable to-day is surely not worth discussion; nations as well as individuals have to pay interest on their loans. According to "Politicus," the 15*s*. 6*d*. war savings certificate would be to-day worth 1*l.* because the nation will pay 1*l.* for it in five years' time. I fear that he stands alone in this valuation. H. Louis.

Man's Ancestry.

In relation to your reviewer's interesting notice in Nature for June 27 of Prof. Wood-Jones's booklet, "The Problem of Man's Ancestry," it is appropriate to remember that the "blood-reaction test" shows the relationship of man to the ape to stand exactly as that of the horse to the donkey; the latter have had a common ancestor. Taking man as equalling 100, the ape comes at 70; the numbers for the horse and the donkey are the same. But this test shows no blood relationship whatever between man and the lower animals, thus confirming Klaatsch's view that the human line became separated very far down at the basis of the vertebrate phylum. W. Woods Smyth.

Maidstone, July 3.

The similarity in the reaction of human and anthropoid blood is the most convincing evidence we have of man's close relationship to the gorilla, chimpanzee, and orang. The classical experiments on blood immunity and blood relationships carried out by Prof. Nuttall, of Cambridge, in the opening years of the present century assured him that those anatomists were right who brought man and anthropoid apes from a common stock. All the biological evidence collected since 1904 has supported Prof. Nuttall's conclusion. When attempts have been made to transmit diseases which are peculiar to man, such as syphilis and typhoid, it has always been found that the great anthropoid apes are more susceptible than any other primate, and much more than any other mammal. When physiologists wish to discover the action of any particular part of the human brain they invariably select an anthropoid ape as the subject most likely to yield the information which is being searched for. But I do not know of any anatomist who has claimed that the relationship between man and the gorilla or between man and the chimpanzee is as close as that which exists between the horse and ass. The structural difference between the gorilla and chimpanzee is greater than that which differentiates the horse from the ass; the structural difference between man and the gorilla is still greater.

It is for those who hold that man has arisen by an independent line from a primitive mammalian stock to explain why man's blood gives no reaction with the blood of lower animals. If it is true that man is a primitive form and retains primitive characters, then we should expect his blood to yield such reactions. The fact that it does not supports the usually accepted hypothesis that man has arisen from an anthropoid stock. The Reviewer.

POSITION AND PROSPECTS OF THE HOME TIMBER SUPPLY.

THE utility of forests to a nation is one of the economic factors to its well-being which have been brought to an unforeseen prominence during the world-war; and perhaps to no other European nation has this unlooked-for development proved so startling, because so totally unsuspected, as to ourselves.

Our woods were not grown from the commercial aspect—sport, amenity, and shelter to crops and stock were their main *raison d'être.* We did not consider it necessary to grow woods for purely commercial reasons—that is, for the sake of the timber and pit wood and paper pulp, etc., they would yield. We obtained our requirements in these commodities by importing them from abroad, and relied on the Navy being able to safeguard these imports. We have now discovered our mistake and are paying for it. The timber purchased in 1915 and 1916 cost 37,000,000*l.* more than it would have done in 1909–13.

On the Continent it was thought that the utility of the forest to a nation was thoroughly understood, but a study of Continental text-books discloses the fact that, so far as modern warfare is concerned, even there the value of the forest and its close connection with the operations of the contending armies were but dimly foreseen. It may be on record, perhaps, in the archives of the German War Office that an exceptionally large demand for timber might prove one of the essential factors to the successful waging of a great war. But it is doubtful whether the Germans even foresaw the magnitude of the demands; and, in any event, they would have calculated on obtaining their requirements in this respect from the countries they overran—as, in fact, has been the case in France, Belgium, Poland, and elsewhere. Nor was it anticipated that the destruction of forests would be so heavy in the fighting zones. In the western provinces of Russia, for instance, from which the Baltic ports were mainly supplied, some 16,000,000 acres of forest have been destroyed! This in itself will limit the amount we are likely to receive from the Baltic in the future. Destruction and heavy fellings are, then, taking place throughout Europe, and, with our timber imports reduced to a negligible amount, we have now been felling heavily for some time past in our own small area of 3,000,000 acres of woodlands, of which probably not much more than half will be commercially exploitable. It will be alike useful and of interest to consider briefly the present position and future prospects of this timber question.

Almost from the outbreak of war we have been living a hand-to-mouth existence so far as timber supplies are concerned. The first troubles arose with the pit-wood requirements of the collieries, and the matter has remained a difficult one throughout. Our position as the coal producer and coal merchant of the Allies has rendered it essential to keep the collieries working at full pressure. Previous to the war three-quarters of our pit-wood supplies came from Russia and France; this amount was cut off at a moment's notice with the closure of the Baltic ports and the calling to the colours of the French woodcutters. The price at once rose, and though the imports continued for some time, the increasing demands made upon tonnage for other purposes, coupled with the German submarine campaign, gradually reduced them to a very small figure. We had to fall back upon our home woods for this product. A demand also quickly arose for ash with which to fashion the handles of entrenching tools; but the use of this wood for the purpose was afterwards altogether eclipsed by its introduction into the construction of aeroplanes. The country is now being ransacked for ash of high quality, and the price has greatly increased.

During the first eighteen months of the war the hutting of the New Armies absorbed large amounts of soft timber, the material consisting mostly of imports. With the improvement in trench construction, dug-outs, lines of communication, and so forth, large orders for sleeper material, planks, etc., had to be fulfilled, and considerable areas of old forest and young pole forests were felled (the pole woods at a sacrifice). The latter were used for wire-entanglement posts, field telephones, corduroy roads, and gun-pits, of which numerous illustrations have appeared in the pictorial Press. Packing cases for stores also absorbed large amounts of wood. Later on a new demand arose: for the building of the network of light railways behind the front sleepers were required in enormous numbers, and by then we had been driven almost entirely to rely on our own home woods, inadequate and poorly grown as they were, and such areas of forest in France as our Ally made over to us. In Great Britain we have become acquainted with Canadian and Newfoundland lumbermen and their methods, with Portuguese, German prisoners, and others, companies of whom are at work throughout the length and breadth of the country.

Many ask, What is to be the end of it all? The answer is not difficult. We shall have to be prepared to sacrifice all the woods in this country which are commercially exploitable. This is the present position. If the war lasts long enough they will go into the war furnace and the material be lost to us so far as any future utility is obtainable from it. If the war comes to an end in the latter part of this year or early next year, still the balance will have to go in the course of a few years. For the demand for timber after the war will be as great for some years, so far as can be foreseen, as it is at present, and the supplies, owing to tonnage difficulties, short of the demand. Practically all our timber-using industries, where not employed on war work, are non-existent, of which house-building occupies a prominent position. We are all aware of the difficulties with which the paper trade, publishers, and the Press have to contend. These troubles have become chronic. It will be necessary to restart all these industries after the war. Timber prices will remain high, and fellings in our home woods will have to continue to help supplies. This is the present position so far as it can be foreseen.

Now as to future prospects. From what has been already said it is obvious that British woods will only be able to supplement the supplies which will be required during the period immediately following the peace. Even if we undertake, as it is to be hoped we shall, a large afforestation scheme in these islands when the war is over, the woods will not yield pit wood before twenty to thirty years after formation, and timber in fifty to sixty years. We require, therefore, to make some arrangement to ensure adequate supplies during the next forty to fifty years. The old conditions in the North European timber markets, in which we reigned supreme at the outbreak of war, will not return. Some of our present Allies, previously nearly self-supporting, will be our competitors in these markets in the future. What arrangement is, then, necessary to ensure supplies for the above period at a reasonable figure? The problem requires to be faced and settled at an early date. It is one of the urgent problems in connection with reconstruction work. In the past, Russia, Norway, and Sweden sent us the bulk of our imports of soft woods, pine, spruce, and larch, Russia being the chief supplier. It is known that Norway and Sweden are nearly cut out. A few years will see their exports dwindle to a figure far below the pre-war one. We shall have to face competition in markets which will be shrinking. It is therefore imperative that new sources of supply should be tapped. So far as Great Britain is concerned the two countries where such new sources exist are Canada and Russia.

Canada.—Canada has long been looked upon by Great Britain as a timber El Dorado. We know for a fact that she has a gigantic reserve of untapped timber. All agree that the Douglas fir forests of British Columbia are magnificent. It may therefore be admitted at once that we can reasonably hope to obtain a certain portion of our requirements from Canada during the period under consideration. But there are certain factors in this matter which should not be overlooked. The chief are, first, the extent to which the forests accessible to us—*i.e.* accessible from the point of view of the price to be paid for the material—have been cut out; and, secondly, the manner in which the future great competition by America, who has mostly cut out her gigantic forests and is an enormous consumer of timber, will be likely to affect the Canadian market and its prices. Canada and Newfoundland together sent us only about one-tenth of our coniferous timber and pit wood before the war. In the future these imports may be increased, but any increase must inevitably be guided by the ordinary laws of supply and demand. Canada, we may infer, will sell her material, or the greater bulk of it, in the best market. This market, because the closest, will be the American. The timber imported from Canada in the past was practically all water-borne, cut on the banks of the rivers and floated out, this being the cheapest form of carriage. The freights on long railway and road carriage would kill Canadian timber exports to this country, since we could not afford to pay the price. Opinions differ a good deal as to the amount of Canadian timber which remains accessible to us—*i.e.* accessible at a price we can afford economically to pay.

The other point, the competition with America, is a more difficult and delicate one. In the early years of this century America endeavoured to negotiate with Canada a preferential tariff on wood pulp. This question may be expected to crop up again. America must in the future be a very large importer of Canadian timber; and although we may hope to obtain a certain proportion of our requirements from Canada during the next forty years, it would not be a good policy, or even economically sound if another way out can be found, to stand in Canada's way by asking her to forgo a certain part of a large and profitable market at her door in order to bolster up a more distant one at a financial loss to herself. On the other hand, our timber industries could not afford to pay the same price as American ones *plus* the additional transit charges to this country. The question of tonnage does not affect the matter save in so far as the shorter the distance the material has to be carried, the simpler the tonnage arrangements.

Russia.—I have given some study to the Russian forests for the past decade and more, and had an opportunity last year of discussing the problem of their exploitation with several members of the Russian Provisional Government and assistant Ministers. Russia has an enormous area of undeveloped forests. Those of interest to us are situated in the Archangel, Vologda, and Olenets Governments, Archangel and Alexandrovsk being the ports of shipment, the chief species being pine, spruce, and larch. Before the war our chief imports from Russia came from the Baltic ports. I have already given the reasons for regarding the revival of these imports after the war as improbable. What remains of those forests, I was credibly informed, Russia will require to keep for herself. I have long held the opinion that, with the inevitable decrease of the exports from some of the countries supplying Great Britain, which were all felling primeval forest, we should have to go to Russia for an increasing amount of our requirements. The war has brought about this condition and rendered our position more difficult owing to the fact that we shall now have to face competition to a degree previously non-existent. It has become an economic necessity for us to obtain a proportion, the larger proportion, of our requirements in soft woods from the Russian forests during the next forty to fifty years. The only point for consideration is, Are we going to make arrangements to obtain them direct, or are we going to obtain them from middlemen and pay the middlemen's profits?

In March, 1916, I put forward the suggestion that we should come to an arrangement with the Russian Government whereby areas of a sufficient size to furnish us with a definite proportion of our requirements should be leased to us. With this end in view I went to Russia last year. I visited portions of the forests in the Archangel and Vologda Governments, and discussed the matter thoroughly with members of the Government. This Government had decided upon an arrangement under which it was prepared to favour the Allies as against the Central Powers with reference to granting facilities to capital for the development of the valuable unexploited resources of Russia, of which her forests will prove the easiest to commence with. The Government was proposing to grant concessions in the big forests of the north-east in blocks of 500,000 acres, each concession to be for a period of thirty to thirty-five years. The working of these blocks would be granted to foreigners who were prepared to provide the necessary capital and would undertake to fashion the material in Russia before export—*i.e.* convert it into sawn material, wood pulp, etc. I was informed that the Provisional Government was prepared to come to an agreement with the British Government on these lines, that, in fact, we could acquire an area or areas of Russian forest which would enable us to assure a proportion of our future requirements, our necessities, in the soft woods which are of such great importance to our industries.

This was the position when the Provisional Government was swept away and the Bolsheviks came into power. The present phase in Russian politics may be regarded as a transition stage. When a stable Government supervenes we should be ready to take advantage of this opportunity to remove all anxiety on the score of the future timber supplies of this country. If we do not seize the opportunity we may be certain that others will do so, in which case, since the material is essential to our wood-using industries, and, therefore, must be obtained, we shall have to pay middlemen's profits to the foreigner, the Swede, Norwegian, and so forth, who, having exploited their own forests, would wish to maintain their exports to Great Britain by felling in the Russian forests.

E. P. STEBBING.

INDIGO IN BIHAR.

THE present position and future prospects of the natural indigo industry in India have of late been the subject of renewed and intensive study. Two interesting articles, in which the actual situation is partly summarised, have recently appeared.[1] These papers supply a concise review of the growth of the synthetic indigo industry and of the displacement since 1897 of natural indigo by the synthetic product. By 1910 the cultivation of indigo in Java had almost become extinct, the crop there being largely replaced by sugar. By 1914 the manufacture of indigo had practically ceased in all the provinces of India except Bihar, where alone the industry was in European hands and was conducted in well-equipped establishments. The area under indigo, which in 1895 was nearly 1,700,000 acres, had shrunk to less than 150,000 acres. The price per lb., which in 1897 was still from 7*s.* to 8*s.*, had fallen, in the early part of 1914, to 3*s.*

With the cessation of the supplies of German synthetic indigo which accompanied the outbreak of hostilities, the prices of Indian indigo were nearly quadrupled, and this high figure was main-

[1] "The Present Position and Future Prospects of the Natural Indigo Industry." By W. A. Davis, Indigo Research Chemist to the Government of India. *Agricultural Journal of India*, vol. xiii., parts i. (January) and ii. (April), 1918.

tained throughout 1914–15. There was a slight fall during 1915–16, but 1916–17 saw a reversion to the 1914–15 standard, which has continued. There was a corresponding increase in the area under the crop; this, during 1916–17, was three and a half times as great as the average for the preceding five years. There has been a similar rise in the quantity of indigo exported from India; four times as much was dispatched abroad in 1915–16 as had been shipped during 1913–14. But the total area under the crop in 1916–17, which exceeded 756,000 acres, still remained less than half what it had been in 1895, while the total production in 1916–17, which amounted to 95,500 cwt., was little more than half the output of 1896, which had been 187,000 cwt.

The view held in circles well qualified to judge is that this marked increase in the production of the natural dye since the war began can be regarded only as temporary, the synthetic dye being now too well established ever to be displaced. There is much to be said for this view. Since the war began, the actual output of the dye from the various Indian provinces in which by 1914 the industry had practically become extinct has exceeded that from Bihar. Yet in these provinces the industry had been in the past, and is now being, conducted in a somewhat primitive fashion by methods that result in a relatively poor yield of a product of low quality. The author of the papers before us nevertheless hazards the suggestion that, provided certain improvements in actual practice can be effected, the natural product may "be able to put up an interesting fight with the synthetic dye." It is, however, admitted that the possibility of maintaining that contest must depend upon the retention or the capture of an Eastern market.

An equally lucid and well-illustrated review of the methods of manufacture which obtain in Bihar is given in the second of the articles under notice. The indigo plants there cultivated are two in number: *Indigofera sumatrana*, an Asiatic form, which is still the chief source of the dye in Bihar, first introduced to north-eastern India as a crop in the later years of the eighteenth century; and *I. arrecta*, an African species, first brought to India from Java so recently as 1899. The latter species as a rule yields more green plant per acre than the former, and always produces far more dye per 100 maunds of plant. The two demand different treatment, for *I. arrecta* may be sown in October and is ready for a first cutting in late May or early June following, whereas *I. sumatrana* cannot be profitably sown until February, and as a rule is not cut until mid-July. Another advantage in the case of *I. arrecta* is that this species suffers less from flooding and water-logging than *I. sumatrana* does. One of the most important considerations connected with the future prospects of natural indigo in India therefore is an increase in the cultivation of *I. arrecta* in preference to *I. sumatrana*, so as to cheapen the production of the dye. Unfortunately certain serious difficulties, chiefly of a botanical nature, are met with in the management of what is still a comparatively new and correspondingly unfamiliar plant in Bihar.

The most fundamental of these difficulties, which relates to the identity and the original home and habitat of the plant itself, was definitely settled on behalf of the indigo industry by the officers of the Indian Botanical Department in 1902. The remaining difficulties, which are of a physiological and pathological nature, have been the subject of study by the Indian Agricultural Department during the past ten years. The author of the papers now under notice has promised to deal with these difficulties and to indicate the means by which they may be overcome; also to consider how far existing methods of manufacture in Bihar are imperfect and to explain how these may be improved. His further contribution to the general subject will therefore be looked forward to with interest.

PROF. ALFRED SENIER.

PROF. ALFRED SENIER, who died on June 29 at Galway, was born at Burnley on January 24, 1853. His parents, about two years after his birth, emigrated to Wisconsin, where he received his early education. In due course he attended the Universities of Wisconsin and Michigan, and graduated as doctor of medicine of the latter in 1873. But his interest lay principally in the subject of chemistry, and, returning to England, he filled, under Prof. Attfield's direction, the posts of assistant and demonstrator in chemistry to the Pharmaceutical Society in London from 1874 to 1882, and, afterwards, for about three years, that of lecturer in chemistry in St. John's College, Battersea, of which the Rev. Canon Daniel was at that time principal. He then became a research student with Prof. von Hofmann, and after a period of three years received the degree of Ph.D. from the University of Berlin. His inaugural dissertation, "Ueber Cyanursäure, ihre Isomeren und Derivate," on receiving this degree, was published. In 1890 he became *locum tenens* for Prof. Maxwell Simpson in Cork, and in 1891 he was appointed professor of chemistry and lecturer in medical jurisprudence in Queen's College, now University College, Galway.

Prof. Senier's researches in organic chemistry were devoted mainly to the cyanuric acids, to the acridines, and to phototropic and thermotropic phenomena. He proved the non-existence of α- and β-cyanuric acids, and his discovery of hexamethylacridine and α-naphthacridine led to the investigation of new acridine derivatives, to new methods of inquiry, and to the discovery of new types of acridine compounds. In his presidential address to Section B of the British Association in 1912, he dealt with the salient features of his work on phototropy and thermotropy.

He was always greatly interested in philosophical subjects, and was familiar with the topics and controversies of philosophy and logic. With Dr. W. R. Dunstan, he was instrumental in founding the Aristotelian Society in 1880. He was hon. secretary and treasurer of this society from its foundation until 1884, and was made an hon. member in 1902.

Prof. Senier took an active part in all matters connected with the government of Galway College and of the National University of Ireland. He was a member of the governing body of the college and a member of senate of the university, and possessed in a high degree the qualities that are essential for securing efficiency in a position of responsibility in the administrative work of a university. He was a fellow of the Chemical Societies of London and Berlin, a fellow of the Institute of Chemistry, a member of the Royal Irish Academy, and an honorary doctor of science of the late Royal University of Ireland.

NOTES.

THE French National Fête Day is July 14, but as the date fell on a Sunday this year it was celebrated with much enthusiasm in London on Friday and Saturday. Last year the sum of 200,000*l*. was raised on "France's Day" for the French Red Cross, and this year it is expected that a total of a quarter of a million pounds will have been reached. The festival was made particularly noteworthy by messages which were dispatched to France by many leading societies and institutions in Great Britain, among them being the following:—*Royal Society:* The Royal Society of London sends greetings to the French nation, and more especially to its scientific men. It recalls the intimate friendship which since their foundation has bound together the Académie des Sciences with its own body. Always united in their endeavour to promote the advance of science, they are now joined in their efforts to defend the cause of civilisation and freedom. *British Association:* Nineteen years ago the Dover meeting of the British Association was "so arranged that two great nations which had been, a century earlier, grappling in a fierce struggle should in the persons of their men of science draw as near together as they could." Another joint meeting with France was on the point of taking place when our high hopes of lasting general peace were so cruelly destroyed. But out of the destruction has arisen a far closer union of our two peoples, and an even brighter prospect of our future co-operation for the good of humanity and of science. *Royal College of Surgeons of England:* Brothers-in-arms, we greet you. Bound by ancient ties of blood and by the memories of many a gallant contest in the past, to-day we stand as one nation united in a sacred cause. We have before us a happy presage from the past. As the united efforts of Pasteur and Lister have laid low the tyranny of disease, so shall France and Britain conquer a tyranny still more remorseless. Our future brightens, and shall endow Gaul and Briton with a common birthright to remain a splendid heritage for all time. *British Academy:* To France, who has so often inspired and led civilisation in Europe: to France, who upholds the banner of intellectual freedom and unfettered thought; to France, who for nearly four years has endured brutal outrage and the violation of all decencies of humanity and civilisation, the British Academy, in the name of British scholarship, sends on this great anniversary a renewed assurance of loyal fraternity and of unshaken determination to continue the conflict until liberty is secured and French soil delivered from the desecration of the invader.

THE prevailing epidemic of so-called influenza is widespread both in this country and on the Continent. The most striking symptoms are sudden onset with chills, headache, and pain in the neck, back, loins, and limbs, with general malaise. Fever is present, ranging from 102° to 104°, or even 105° F., but generally disappears almost suddenly on the third or fourth day of attack, and the individual rapidly convalesces. On the whole, the disease is quite mild and unattended with complications. It differs from the true influenza, which was so prevalent in 1889 and the early 'nineties, by being milder and of shorter duration, and by the rapid convalescence. The true influenza is caused by Pfeiffer's bacillus, a minute rod-shaped microbe abundant in the bronchial secretion. As regards the present disease, Capts. T. R. Little, C. J. Garofalo, and P. A. Williams state that they have investigated a number of cases and entirely failed to find the *Bacillus influenzae*, but a gram-positive diplococcus appears to be constantly present in the naso-pharynx, throat, and sputum, which they tentatively regard as being the causative organism (*Lancet*, July 13, 1918, p. 34). The *Lancet* suggests that the disease would be better named "catarrhal fever."

THE following grants of money for research committees were voted by the General Committee of the British Association at the meeting in London on July 5:—*Section A.—Mathematical and Physical Science:* Seismological investigations, 100*l*.; discussion of geophysical subjects, 10*l*. *B.—Chemistry:* Colloid chemistry and its industrial applications, 5*l*.; non-aromatic diazonium salts, 7*l*. 7*s*. 8*d*. *D.—Zoology:* Inheritance in silkworms, 17*l*. *F.—Economic Science and Statistics:* Women in industry, 10*l*.; effects of the war on credit, etc., 10*l*. *H.—Anthropology:* Palæolithic site in Jersey, 5*l*.; archæological investigations in Malta, 10*l*.; distribution of Bronze-age implements, 1*l*.; age of stone circles, 15*l*.; anthropological photographs, 1*l*. *I.—Physiology:* The ductless glands, 9*l*. *K.—Botany:* Heredity, 15*l*.; Australian Cycadaceæ, 7*l*. 17*s*.; Australian fossil plants, 15*l*. *L.—Educational Science:* The "free-place" system, 5*l*. *Corresponding Societies Committee:* For preparation of report, 25*l*. Total, 268*l*. 4*s*. 8*d*.

THE death of Mr. Isaac Beardmore is recorded in the *Engineer* for July 12. Mr. Beardmore, who was eighty-two years of age, was joint proprietor, and was associated with the management, of Parkhead Forge, Glasgow, for about twenty years. Under his control the Parkhead Forge was converted from an iron to a steel works in 1878–80.

THE death is announced, on July 14, at seventy-seven years of age, of Dr. R. O. Cunningham, emeritus professor of natural history and geology, Queen's College, Belfast. Dr. Cunningham was naturalist to the survey of the Straits of Magellan and author of "Notes on the Natural History of the Straits of Magellan" and "On Reptiles, Amphibia, Fishes, Mollusca, and Crustacea obtained during the Voyage of H.M.S. *Nassau*."

TWO Chadwick public lectures were delivered by Prof. D'Arcy Thompson last month at the Mansion House, London, and the Surveyors' Institution, Westminster, respectively. Abstracts of these lectures have been published in the *Fish Trades Gazette* of June 29 and July 6. The first dealt, in general, with the fishing industry of Europe, and in particular with the line and trawl fisheries of Great Britain. The second had for subjects the great herring fishery of the Scottish and English east coasts, the growth of the industry and its administration, and the origin of the fishing population.

A SEPTUAGENARIAN engineer of distinction, with a long record of useful public and private service, has passed away in the person of Mr. George Waller Willcocks, C.B., whose death occurred on July 7. His most prominent work in this country was in connection with the Local Government Board, which appointed him its chief engineering inspector in 1902. Some time previously he had been, first chief assistant, and then chief, hydraulic engineer for Ireland, until the office was abolished in 1890, when he received the thanks of the Irish Executive for his services. Mr. Willcocks had also considerable foreign and colonial experience. After several years with the East London Railway, he went out, in 1869, to Hungary, to engage in railway development in that country, and, in 1880, he was in South Africa, constructing waterworks in Natal and Cape Colony. His private practice included much Parliamentary work on railway Bills, and he also reported to the Thames Conservancy on the condition of the river from Purfleet to the sea. He was a member of the Institution of Civil Engineers, having been elected in 1873.

THE Electrical Research Committee, which was appointed last autumn, under the auspices of the Department of Scientific and Industrial Research, is at present engaged in superintending a research on insulating materials (fibrous materials, porcelain, ebonite, mica, composite materials) and the waterproofing treatment of insulating windings of electrical machines, in respect of which grants have been made to the Committee by the Research Department, the British Electrical and Allied Manufacturers' Association, and the Institution of Electrical Engineers. The Committee consists of three members nominated by the institution, and three members nominated by the B.E.A.M.A., the nominees of the former being Mr. C. H. Wordingham (chairman of the Committee), Mr. C. C. Paterson, and Mr. C. P. Sparks, and those of the latter Mr. F. R. Davenport, Mr. D. N. Dunlop, and Mr. A. R. Everest. The temporary address of the Committee is 1 Albemarle Street, London, W.1, and the secretary is Mr. P. F. Rowell.

JUNE this year was generally cold and dry over the United Kingdom, and for the first month of summer was far from seasonable. At Greenwich the mean temperature for the four weeks ending June 29, as shown by the weekly weather reports of the Meteorological Office, was 57·3° F., which is 2° below the normal. The greatest deficiency of temperature occurred in the closing week, when the mean was 56·7° and 4° below the normal. The maximum shade temperature in each of the last two weeks, ending June 22 and 29, was 73°, and for the week ending June 15 was only 74°. For one-half of the days in June the London temperatures failed to touch 70°. It is, however, not necessary to go further back than two years for an equally unsatisfactory record, the weather being decidedly colder in June, 1916, when the mean temperature for the month at Greenwich was 2° lower, and there was a greater absence of warm days. The month this year was drier. The total rainfall for the four weeks ending June 29 at Greenwich was 0·75 in., which is 1·06 in. below the normal, and 41 per cent. of the average. There was no rain in the week ending June 8, and only 0·06 in. for the week ending June 29. In the Midland counties the total rainfall for the four weeks ending June 29 was 0·91 in., and in the south-east of England 1·01 in. The report for the week ending June 29 states that the deficiency of rainfall in the South of England has been almost continuous since the week ending May 11, the deficiency for that period being 38 mm. or 1·50 in., and the total measurement in seven weeks is only 51 per cent. of the average.

WE have received from Miss M. M. Brinkworth, 3 Mount Beacon, Bath, an example of a peloriate Viola flower. Pelorisation with or without spurs has been observed in various species of this genus, but the case illustrated by Miss Brinkworth's specimen differs in showing a concomitant increase in the number of sepals and petals.

SOME interesting explorations were made in Spitsbergen last year by M. Adolf Hoel and Capt. S. Rövig, of the Norwegian Navy. A short paper in *La Géographie* (vol. xxxii., No. 2, 1918) gives the chief results. The territory examined was in the south, chiefly between Bell Sound and Horn Sound. M Hoel denies the distinction generally made between the Archean and Hecla Hook formations on the west coast. He claims to have discovered in the Hecla Hook beds north of Horn Sound rocks characteristic of the so-called Archean formation of Spitsbergen. All these rocks, at least in the south of Spitsbergen, he attributes to pre-Devonian, probably Silurian, times. M. Hoel further claims to have discovered Tertiary rocks on the west coast between Horn Sound and South Cape. The paper also contains some information about the Horn Sound glaciers. Finally, there is news of increased mining activity, including new claims and the encroachment of certain Scandinavian claims on British estates.

A REPORT (vol. ii., A.5) on the Danish Oceanographical Expeditions of 1908–10 to the Mediterranean and adjacent seas deals with the distribution and life-histories of the fishes belonging to the families Argentinidæ, Microstomidæ, Opisthoproctidæ, and Mediterranean Odontostomidæ. The report, written by Dr. Joh. Schmidt, refers almost entirely to the collections made by the author himself on board the Danish Fishery Research steamer *Thor* during the years 1903–10 in the north-eastern Atlantic, and later on in the Mediterranean. It is entirely systematic. There are very clear charts showing the distribution of the fishes collected, and special attention is devoted to larval and post-larval forms, a large number of these being described and figured.

BULLETIN No. 11 of the Department of Fisheries for the Province of Bengal and Bihar and Orissa (Calcutta: Bengal Secretariat, 1918) consists of an account of investigations on the Hilsa undertaken during 1917, and also of a summary of previous work. The Hilsa is a very highly esteemed Indian food-fish. It is a Clupeoid (*Clupea* or *Hilsa ilisha*), and, like the salmon, it is an anadromous fish ascending rivers from the sea in order to spawn. From the time of Francis Day (1873) it has been the subject of more or less unsuccessful investigation. Day, recognising that the existence of weirs or anicuts presented great difficulties to the upward passage of the fish, advised a kind of under-water fish-pass, which does not seem to have been successful The Madras Fisheries Department instituted research into methods of artificial culture in 1909, but this was apparently dropped. The present (Bengal) Department began again about the same time, and, after sending a superintendent to America to study methods of shad-culture, tried to propagate Hilsa on the same lines, but without success. In this paper Messrs. T. Southwell and B. Prashav examine the methods, discuss the reasons for failure, and suggest further investigation.

THE May issue of the *Veterinary Review* (vol. ii., No. 2) contains, in addition to the reviews and abstracts of veterinary literature, a useful article by

Prof. Railliet on oxyurosis in the horse. After giving an account of the history and characters of the genus Oxyuris, the author describes the cosmopolitan species, *O. equi* (*curvula*). He holds that there is no warrant for referring to different species, as Jerke has done, the short-tailed and long-tailed females, for these gradually merge, and they agree in all other essential characters, and the males are identical. In Prof. Railliet's opinion the correct view is that *O. equi* has polymorphic females. A summary of the pathogenic effects of these worms is given, and observations on the life-history cited, which indicate that the species has a direct development.

DR. J. SCHWETZ contributes to the *Annals of Tropical Medicine and Parasitology* (vol. xi., No. 4) observations on the habits of three species of tsetse-flies—*Glossina brevipalpis, fusca*, and *pallidipes*—in the Belgian Congo. These three and two other important species—*palpalis* and *morsitans*—select as resting-places the trunks and larger branches of trees. In regions where they exist *brevipalpis* and *pallidipes* are not restricted to limited belts, but, like *morsitans*, are found uninterruptedly over large stretches of country. *Brevipalpis* accommodates itself to forest, park land, and wooded savannah, but *pallidipes* (like *morsitans*) does not inhabit the forest, whereas *fusca* occurs only in the forest, and, in fact, only in moderately dense forest belts. Where it does occur *fusca* is not uncommon and is sometimes even abundant; Dr. Schwetz states that his two trained native boys collected more than 500 specimens in a few weeks. This species does not fly during the day, like *morsitans* and *palpalis*, but remains motionless on tree trunks, being only occasionally stimulated into flight by the passing of men and animals. Its definite period of activity is an hour or two after sunset, and anyone passing then through a haunt of this fly is sure to be attacked by numerous specimens. The haunts of *brevipalpis, pallidipes*, and *fusca* are almost exclusively along roads and paths.

WE have received a pamphlet on the Rockefeller Foundation compiled by its president, Mr. George E. Vincent, being a review of its war-work, public health activities, and projects for medical education in 1917. The war-work includes a military base hospital of seventy beds erected in the grounds of the Rockefeller Institute in New York City, which embodies features which French and British practice has proved essential in a base hospital; here military and naval medical officers are sent for study and experience. A tuberculosis campaign has been instituted in France. The training of sanitary medical officers is being promoted by the foundation and maintenance of a school of hygiene at the Johns Hopkins University. Public health work is being carried out in many lands. The control of hookworm disease (anchylostomiasis) is being studied in several States of the Union, in Brazil, Siam, Fiji, and China. Malaria is being dealt with in some of the southern States, yellow fever in South America, medical education is being aided in China, and contributions of funds and material have been given to the American Red Cross. Truly a fine record, which has been rendered possible mainly by the princely donations of the founder, Mr. John D. Rockefeller.

THE phenomena of concretionary growth receive discussion in two recent memoirs of the Canadian Geological Survey. In Memoir 101 Mr. W. A. Johnston refers to the importance of elevation above the local water-table in promoting the formation of concretions in certain marine Pleistocene clays. In Memoir 102 Mr. T. T. Quirke discusses clay-balls in fluvioglacial clays in the Espanola district of Ontario, giving useful references to the analogous "marlekor" or Imatra stones of Fennoscandia.

WHEN Dr. L. L. Fermor showed, in 1906, that a crystalline form of psilomelane existed in Central India, he was without evidence of the system to which it should be referred. He now (Records Geol. Survey of India, vol. xlviii., p. 103, 1917) shows from a careful investigation that hollandite crystallises in the scheelite class of the tetragonal system, a bipyramidal class without vertical planes of symmetry, here styled "pyramidal" without further qualification. Dr. Fermor regards romanèchite, which was named but not described by Lacroix in 1900, as a hollandite with more water and less ferric oxide. Since the accents vary in the paper, it may be remarked that the grave accent is correct, as in the village name of Romanèche.

MR. P. W. BRIDGMAN (*Amer. Journ. Science*, vol. xlv., p. 243, 1918) has prepared a number of cylinders of rocks and crystals with central cavities drilled in them. These have been subjected in a jacketing cylinder of chrome-nickel steel to pressures up to 12,000 kg./cm.². Disintegration takes place from the walls of the cavity, and it gradually becomes filled with flakes and sand. In the case of crystals, the splinters have no obvious connection with the crystalline symmetry. Even the flaws in the original specimens appear to play no part in this secondary fracturing; they are probably already closed tightly by natural pressure. The author concludes that "minute crevices, at least large enough for the percolation of liquids, exist in the stronger rocks at depths corresponding to 6000 or 7000 kg./cm.², and possibly more."

A CONTRIBUTION to the question of the origin of kaolin in deeply seated rock-masses is made by Messrs. S. Paige and George Steiger of the U.S. Geological Survey (Journ. Washington Acad. Sci., vol. viii., p. 234, 1918). In connection with the chalcosine deposits of Tyrone, New Mexico, even quartz has become replaced by kaolin. It is suggested that sericite, which occurs abundantly as an alteration-product of felspar in the local porphyries, has become decomposed by solutions containing sulphuric acid from the copper ores. Fluorine, which is shown to exist in the sericite, is thus set free, and this has enabled the quartz to disappear in solution. Kaolin, resulting from the attack made upon the sericite, takes the place of the quartz in the final mass. The effect of descending solutions from sulphide ores in promoting the kaolinisation of sericite is also referred to by Mr. J. Coggin Brown in his recent description of the mines of galena and zinc-blende at Bawdwin in the North Shan States (Records Geol. Survey of India, vol. xlviii., p. 171).

THE French are turning their attention just now to the Pyrenean region, where considerable water-power is available for industrial purposes. A number of chemical factories have been, or will be, installed in the region. Of special importance (according to an article in *La Nature* for June 29) is the manufacture of calcium carbide, artificial fertilisers, and cyanates, while it is also hoped to develop the mineral deposits and treat them cheaply in the large factories, which will give ample power for the purpose. The bauxite deposits will be exploited for the production of aluminium, and the artificial fertiliser industry is sure to receive an impetus when the water-power still available is harnessed. At present only about one-fifth of that which can be produced is utilised. The article gives brief particulars of a number of installations which are already working, and of others which it is hoped to erect when capital and labour are available for the purpose.

THE amplitude of the oscillations produced in a singing arc depends on the curvature of the current-voltage characteristic curve. If i_0 is the constant current upon which the variable current of effective value i_1 is superposed, it is shown (*Revue générale de l'Electricité*, April 20) that $i_1 = k\rho i_0/r$, in which k is a coefficient, ρ the curvature of the characteristic curve at the region over which the oscillations are taking place, and r the resistance of the oscillatory circuit. In this equation i_0 depends on i_1, and also on ρ and r, but if i_1 is not very large, i_0 may be considered as nearly equal to the current that would be obtained with $i_1 = 0$, and the equation would give to a first approximation the effective value of the oscillating current in the singing arc.

IN a lecture at the Technical College, Munich, Dr. A. Traube read a paper on the production of coloured photographs by a process which he calls "Uvachromie." Three photographs are taken through suitable colour-filters, the negatives being copied on ordinary kinematograph films. After fixing, these films are treated in a bath so as to form a chemical compound that readily absorbs colour material. The three component pictures can be coloured and dried in about twenty minutes, and they are then placed in register upon one another, and the coloured photograph is complete. The new process has the advantage that as many copies may be made as are required, the process being rapid and simple. The photograph retains its sharpness of definition, and corrections in colour can easily be made by replacing one or other of the component films in the colour solution for the appropriate length of time.

THE May (1918) issue of *Navigazione interna* (Propaganda dell' Associazione Nazionale del Congressi di Navigazione) gives particulars of the work of the Hydrographic Office of the Po during the period 1914–17. In spite of the war, much useful work has been done by the institution with regard to rainfall observation (the number of observation stations both in the mountains and plains has been increased and new methods of observation have been initiated), hydrography, levelling surveys, measurement of flow of streams, forecasting of floods and dry periods, the measurement of the turbidity of streams, temperature measurements on the waters of the Po, investigation of subterranean streams, etc. Rainfall observation and investigation, in particular, have received a great deal of attention. It is proposed to study Swiss methods of rainfall and snowfall observation, using various modern types of recording instrument, and to correlate and co-ordinate results. Glacier study has also had the attention of the authorities, and results of considerable importance as to the formation of glaciers and their influence on rainfall and temperature in valley regions should be anticipated when this work has been placed on its final basis.

ATTENTION may be directed to a Bulletin just issued by the Engineering Experiment Station of the University of Illinois, entitled "Percentage of Extraction of Bituminous Coal, with Special Reference to Illinois Conditions." It is well known that in coal-mining it is never possible practically to extract the whole of the coal from any given seam, and that a certain percentage is always left behind and lost; furthermore, such loss is admittedly greater on the average in the United States than it is in Great Britain, one of the main reasons being the low price of coal in the United States; "the coal-mining engineer of America accordingly has not had as his problem the development of methods of extraction which would result in the largest percentage of ultimate recovery, but rather the development of methods which would result in the lowest cost of production." From a table given in the present Bulletin it appears that the percentage of recovery of the entire seam ranges from as much as 97 per cent. in the George's Creek Field of Maryland to as low as 50 per cent. in Central Illinois. The subject necessarily requires discussion in detail, since the amount of coal left behind depends in each case upon a large number of conditions, the nature of the seam, its thickness, depth from surface, inclination, character of roof and floor all having to be taken into account, whilst the amount of damage done to the surface and the monetary value of such damage have also to be considered. Although American conditions of coal-mining are very different from those prevailing in this country, the Bulletin will well repay perusal by British coal-miners, especially if it arouses sufficient interest to cause a similar investigation to be undertaken in this country.

ACCORDING to a note in the *Chemical Trade Journal* for June 29, a new radio-active element of considerable emissive power has been detected in the residue from pitchblende, which forms the raw material employed as a source of radium. This residue was subjected to treatment which finally left undissolved only the members of the tantalum group; and this insoluble remainder showed a radiation, at first slight, but gradually increasing largely, which proceeded mainly from the evolution of actinium, and indicated the presence of the new element "protactinium." Experiments for the separation of the element are to be undertaken. The period of semi-disintegration probably fluctuates between 1200 and 18,000 years. The information is based on statements published in the *Münchner Neueste Nachrichten*.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF WOLF'S PERIODIC COMET.—M. Jonckheere, who has been searching for the return of Wolf's periodic comet since May 4, discovered it on July 9 at 10h. 45m. G.M.T. with the 28-in. equatorial at Greenwich. The comet was at the time of discovery between the 15th and 16th magnitude, and about 9″ in diameter. It is about +50s. in R.A. and 15′ north of the place given by M. Kamensky's orbit (A.J. 729). On July 10 the magnitude was estimated as 15th, and on July 12 as 14th. The comet was discovered in 1884, when it was of 8th magnitude, and was observed in the returns of 1891, 1898, and 1911, but not in 1905.

THE NEW STAR IN AQUILA.—The new star has varied but little in brightness during the past week, and was of approximately the 4th magnitude on July 14. The spectrum, however, has shown a further approach to the nebular stage. On July 13 Prof. Fowler observed that in the visible spectrum the enhanced lines of iron were represented only by very feeble lines at 517 and 532, while the line about 501, which would appear to be the chief nebular line, was scarcely inferior in brightness to H_β. The line about H_γ also appeared to have gained in relative brightness, as if the nebular line 4363 had made its appearance. The band at 464 was bright and broad, and a faint band on its less refrangible side was probably 4686. There was also a faint band about the position of the helium line 4471. The group of three bright lines in the region of D was reduced in intensity. It would seem that the loss in magnitude due to the fading out of the enhanced lines and the reduced intensity of the hydrogen lines has been partially compensated by increased intensity of the nebular lines.

An account of photographs taken at Meudon on June 12 and 15 has been given by Mr. J. Bosler (*Comptes rendus*, June 24). In addition to the whole series of hydrogen lines, there were bright lines at 592, 588, 569, 532, 518, 502, 493, and 465, and fainter lines at 648, 638, 555, and 454. The bright lines varied in breadth from 30 to 60 Å., and were accompanied by the usual dark lines on their more refrangible sides; if interpreted in terms of motion, the displacements would indicate a relative velocity of 2300 km. per second, or about $2\frac{1}{2}$ times that observed in any previous nova. Dark lines, apparently without bright companions, occurred at 461, 421, 389, and 3934 (K).

The new line noted by Mr. Phillips on July 4 was about 407, as in Nova Persei on March 21 and 27, 1901; the position previously given was erroneous.

Photographs obtained by Mr. Phillips on July 12 and 13 show a well-defined line on the red side of H_γ, which is doubtless the above-mentioned nebular line 4363. The band at 468 has also been noted in recent plates.

Father Cortie sends the following notes on recent photographs:—"On July 13 a photograph of the spectrum showed that each of the hydrogen bands H_β to H_ζ contained a central brighter region in which were two bright lines. Each band was about 50 Ångström units in breadth. The bright region at wave-length 4640 extended altogether over 160 angstroms, and consisted of two broad bright bands, in continuous spectrum. On June 30 this bright region had a breadth of 90 Ångström units, and on July 8 of 110 units. There was a second bright band beginning at λ 4523, and extending over more than 50 units. The visual spectrum showed H_α very bright, and probably just doubled, D bright, and a continuous patch of colour in the green.

"In the photographs of June 29 and 30 the 4640 band was doubled, the more refrangible component being the brighter. The same is true of H_γ. On July 13, in the 4-in. finder, for a few moments the star itself seemed to be double, the companion just preceding the brighter star in right ascension. This may be an illusion, but is noted in case any other observer has seen the star double."

A NEW VARIABLE STAR IN AURIGA.—By comparison of photographs taken with a 4·4-in. portrait lens towards the end of 1905, Mr. A. Stanley Williams detected a star of varying magnitude situated in Auriga, and he has since then accumulated sufficient visual observations to establish the character of the light-curve (Monthly Notices, R.A.S., vol. lxxviii., p. 483). The position of the star for 1900 is R.A. 5h. 8m. 27s., decl. $+39^\circ$ 57·5′. The discussion of the observations shows that the variation is of the Cepheid type, and the period 18·3563 days. The magnitude ranges from 10·04 at maximum to 10·79 at minimum, and the interval from minimum to maximum is 7·0 days.

FUNDAMENTAL PROBLEMS OF PHILOSOPHY AND SCIENCE.

A JOINT session of the Aristotelian Society, the British Psychological Society, and the Mind Association was held in London on July 5–8. The aim of this session, which has now been held for several years, is to endeavour to bring together the actual workers in mental and neurological science and those engaged in purely philosophical research for the discussion of fundamental problems. The subjects discussed included problems of mathematics and physics, of physiology and biology, of practical psychology, and of pure metaphysics.

Lord Haldane presided at the opening meeting, when Prof. Alexander expounded a new philosophical theory of space and time. His theory is that there is one primitive entity, the matrix or stuff of existence, space-time, and that all forms of mind and matter are complications of it. In the discussion Prof. Whitehead criticised it from the point of view of mathematical physics, and Prof. Pringle-Pattison from that of philosophy.

Prof. Wildon Carr presided at the discussion of the symposium "Are Physical, Biological, and Psychological Categories Irreducible?" The contributors were Dr. J. S. Haldane, Prof. D'Arcy Thompson, Dr. Chalmers Mitchell, and Prof. L. T. Hobhouse. The discussion proved of exceptional interest in the number of illustrations from applied science which were brought to bear on the question. The main problem was the adequacy of mechanistic interpretation as used in physics when applied to the higher spheres of life and mind. The opposing views were represented by Dr. Haldane and Prof. D'Arcy Thompson. Prof. Whitehead, Prof. Nicholson, and Mr. Brierley contributed valuable accounts of experiments in their respective sciences, and Dr. Schiller, Lord Haldane, and others discussed the relation of the problem to philosophy.

Dr. C. S. Myers presided at the symposium "Why is 'the Unconscious' Unconscious?" by Dr. Maurice Nicoll, Dr. W. H. R. Rivers, and Dr. Ernest Jones. The discussion was notable as emphasising a distinct change which seems to be manifesting itself in the theory and practice of psychoanalysis. Many of the distinctive features of Freud's original statement, *e.g.* the endo-psychic censor, seem to be vanishing into the background. There was remarkable unanimity in most of the speakers in regarding "the unconscious" as not simply a force resisting inhibition and baneful in its effect, but as essentially and primarily a force to be identified with the spring of life itself. Besides the three contributors to the symposium, the chairman and Dr. McDougall, Dr. Mitchell, Dr. Crighton Miller, Dr. Constance Long, Dr. Goldsbrough, Mr. Flugel, and Prof. Wildon Carr took part.

The largest attendance was at the meeting on Sunday afternoon, when Mr. A. J. Balfour presided at the discussion of the symposium "Do Finite Individuals Possess a Substantive or an Adjectival Mode of Being?" The contributors were Prof. Bernard Bosanquet, Prof. Pringle-Pattison, Prof. G. F. Stout, and Lord Haldane. In the discussion Prof. Bosanquet defended with noticeable earnestness the view which is identified with the philosophy of Mr. Bradley and himself, the view that the ultimate subject of predication is one and universal, that reality is the absolute. He was opposed by Prof. Pringle-Pattison, who acknowledged, however, a wide ground of common agreement. A more decided opposition came from Prof. Alexander. Lord Haldane, in a very clear summary of the two views, held that the real crux of the problem lay in the antithesis between the concepts of substance and subject, and suggested that the solution is the doctrine of degrees of truth and reality. Prof. Whitehead expressed the point in dispute with mathematical precision in his question addressed to all the disputants, "Is there any substantive existence of a *relatum* which is independent of all or any relation?"

The final meeting was presided over by Prof. Wildon Carr. Two short communications, the first on "The Philosophical Importance of the Verb 'To Be,'" by Miss L. S. Stebbing, the second on "The Summation of Pleasures," by Miss Dorothy Wrinch, both called forth an animated and interesting discussion.

THE MUSEUMS ASSOCIATION.

SOME evidence of the desirability of our educational institutions "carrying on" in war-time is afforded by the excellent results achieved at the annual conference of the Museums Association, held at the Town Hall, Manchester, on July 9–11. In view of the difficulty of entertainment, etc., the conference was curtailed to three days, but as a result of the lengthy sessions each morning and afternoon, and on one evening, probably more actual work was crowded in the three days than during any previous conference. It was remarkably well attended, there being about eighty delegates from England, Scotland, Wales, and Ireland. To the great regret of the members, the president, Mr. E. Rimbault Dibdin, was prevented through illness from attending and giving his address. This was particularly unfortunate in view of the recent efforts of the association to give more prominence to matters connected with the art side of museum work, an aspect which was possibly partly neglected by the association in years gone by. However, by the efforts of the local secretary, Mr. Haward, and the general secretary, Mr. J. Grant Murray, this aspect of the association's work was well to the fore.

The members had the usual experience of hearing a few papers on elementary museum matters, mostly by local authors, but one result of the association's propaganda during the last quarter of a century was amusing. For years the association has endeavoured to make the education committees interested in the museums, and has advocated the appointment of special teachers to devote their time entirely to giving lectures to pupils in museums and art galleries. This has at last been accomplished at Manchester, and, possibly through being unaware of the association's efforts, the various teachers concerned gave details of the nature of their work. The value of museums in war-time was brought prominently forward, and no doubt impressed the various chairmen and members of committees who were present. Bearing more particularly upon the war were:—"The Aims and Objects of the Imperial War Museum," by Lieut. Charles ffoulkes, and "Local War Museums," by Mr. Charles Madeley. Dealing with educational aspects of museums were:—"The Art Museum and the School," by Mr. J. Ernest Phythian; "The Museum in Relation to the School," by (a) Mr. R. Saunsbury, (b) Mrs. B. Bell, and (c) Miss B. Hindshaw; the art side of museum work being represented by "The Preservation, Cataloguing, and Educational Value of Print Collections," by Mr. Isaac J. Williams; "The Museum in Relation to Art and Industry," by (a) Mr. Henry Cadness, (b) Mr. H. Barrett Carpenter; "The Application of Art to Industry and its Relation to Museum Work," by Mr. S. E. Harrison; "Art Museums," by Mr. Fitzgerald Falkner; and "Material and Design in Relation to Craftsmanship," by Mr. Joseph Burton.

The more general subjects dealt with were:—"The Museum and Trade," by Mr. Thos. Midgley; "A Plea for the District Federation of Museums and Art Galleries," by Mr. Robert Bateman; "Arrangement of an Ethnographical Collection," by Mr. Ben H. Mullen; "Local Museums and their *Rôle* in National Life," by Mr. Louis P. W. Renouf; and "Museum and Art Gallery Finances," by Mr. E. E. Lowe; a little relief being given to the somewhat serious proceedings by a humorous paper on "Packing and Removing a Museum of Geology and Antiquities in War-time," by Mr. Thos. Sheppard.

Before and after the meetings many members visited the museums and art galleries for which the Manchester district is so famous. There was an informal dinner at the conference headquarters, the Grand Hotel, on July 10, under the chairmanship of Dr. W. E. Hoyle, and the Lord Mayor of Manchester provided tea for the members at the Town Hall each day. The president for next year is Sir Henry H. Howarth, and the hon. secretary Mr. W. Grant Murray, of Swansea. At the council meeting, held at the close of the conference, it was agreed that the association should meet again next year.

ECONOMIC RESOURCES OF NEW SOUTH WALES.

THE report of the curator, Mr. R. T. Baker, of the New South Wales Technological Museums for the year 1916 shows that these museums are accomplishing much useful work in adding to our knowledge of the economic resources of New South Wales and in securing the better utilisation of these resources. Increased attention is being given to the native timbers of the Colony, especially for the manufacture of furniture, and the museums staff has been able to assist in this direction by supplying technical information regarding the timbers and by adding to the exhibits numerous examples of Australian workmanship in home-grown timber. An elaborate illustrated monograph on the fishes of Australia and their technology was published during the year by Mr. T. C. Roughley. This is designed to meet the large demand that has arisen with the development of Australian fisheries for accurate information regarding the edible fishes of the country. The book also describes the methods in use in the New South Wales fishing industry. A good deal of research work has been accomplished in spite of the difficulties caused by the war, and the staff has taken part, either in an advisory or executive capacity, in several investigations arranged by the various committees that have been formed in Australia for the promotion of munition manufacture or the development of industrial and scientific research. These include an investigation of the use of grass-tree resins as a source of picric acid (New South Wales Munitions Committee) and an inquiry into the economic possibilities of posidonia fibre (Executive Committee of Science and Industry), two subjects which have long attracted attention both in this country and Australia. Perhaps the best known work of the museums is that on the eucalypts, and it is interesting to note that among the papers published during the year two more on this subject were included, the first on the eucalypts of South Australia and their essential oils, and the other on the essential oil of *E. Macarthuri*.

THE TORNADOES OF THE UNITED STATES.[1]

NATURE of a Tornado.—The relation of a tornado to human life and property depends upon its nature. What it *does* is determined by what it *is*. Briefly stated, a tornado is a very intense, progressive whirl, of small diameter, with inflowing winds which increase tremendously in velocity as they near the centre, developing there a counter-clockwise, vorticular, ascensional movement the violence of which exceeds that of any other known storm. From the violently agitated main-cloud mass above there usually hangs a writhing, funnel-shaped cloud, swinging to and fro, rising and descending. With a frightful roar comes the whirl, advancing almost always towards the north-

[1] By Prof. Robert DeC. Ward, Harvard University, Cambridge, Mass., U.S.A. Abridged by the author from the Quarterly Journal of the Royal Meteorological Society, vol. xliii., No. 183, July, 1917.

east with the speed of a fast train (twenty to forty miles an hour or more), its wind velocities exceeding 100, 200, and probably sometimes 300 or more miles an hour; its path of destruction usually less than a quarter of a mile wide; its total life a matter of perhaps an hour or so. It is as ephemeral as it is intense.

Fortunately for man, tornadoes are short-lived, have a very narrow path of destruction, and are by no means equally intense throughout their course. Their funnel cloud, which indicates the region of maximum velocity of the whirling winds, ascends and descends irregularly. Where it descends, the destruction is greatest; where it rises, there are zones of greater safety. The whirl may be so far above the ground that it does no injury whatever. It may descend low enough to tear roofs and chimneys to pieces. It may come down to the ground and leave nothing standing.

Damage and Loss of Life in Tornadoes.—The central low-pressure core of the tornado is surrounded by radially inflowing winds of moderate strength, and then, closer to the centre, by spiralling and ascending winds of terrific violence; strong enough to crush and wreck the strongest buildings; ascending with sufficient velocity to carry aloft objects so heavy that for wind to lift them seems almost impossible. The surface winds which take part in the vorticular inflow and ascent seem to be chiefly responsible for the damage and loss of life. There is, however, an additional factor. The central "core," surrounded by its whirling winds, has its pressure greatly reduced by the centrifugal force of the whirl. It therefore exerts a powerful explosive effect upon near-by air at ordinary pressures, within buildings or in other more or less well-enclosed spaces. This curious but very widely attested explosive effect accounts for many tornado "freaks" which cannot be explained by any controls, either of radially or spirally inflowing winds, whatever their velocity.

The damage done by tornadoes may be roughly classified as follows:—(1) That resulting from the violence of the surface winds, blowing over buildings and other exposed objects, crushing them, dashing them against each other, etc.; (2) that caused by the explosive action; and (3) that resulting from the uprushing air movement close around the central vortex. Carts, barn-doors, cattle, iron chains, human beings are carried through the air, whirled aloft, and dashed to the ground, or they may be dropped gently at considerable distances from the places where they were picked up. Iron bridges have been removed from their foundations; beams are driven into the ground; nails are forced head-first into boards; cornstalks are driven partly through doors; harness is stripped from horses; clothing is torn from human beings and stripped into rags. The damage is greater and extends farther from the centre on the right of the track than on the left, for the wind velocities are greater on the right, as in the "dangerous semicircle" on the right of the track of tropical cyclones.

FIG. 1.—St. Louis, Mo., tornado, May 27, 1896. Wreck of Car Barn. From the Quarterly Journal of the Royal Meteorological Society.

The explosive effects are many and curious. The walls of buildings fall out, sometimes letting the roof collapse on to the foundations; or the roof may be blown off, leaving the walls standing. The accompanying photograph (Fig. 1) illustrates some of the damage which was done by the St. Louis, Mo., tornado of May 27, 1896. The surface of the ground may be swept clean, as if with a broom. Articles may be blown out of houses and carried to great distances. Empty bottles are uncorked; feathers plucked from barnyard poultry; doors and windows blown out; soot rises from chimneys; mud penetrates clothing.

Property damage in the United States due to tornadoes varies greatly from year to year, depending, as it does, upon the "accidental" passage of tornadoes through well-populated or through sparsely settled districts. In half an hour the St. Louis tornado (May 27, 1896) destroyed property to the amount of 10,000,000 dollars in St. Louis alone. In some years the damage for the whole United States falls to but a few hundred thousand dollars.

Fig. 2 illustrates the tragic fate of one family in a tornado (May 30, 1879).[2] A house was moved entirely from its foundation to the south-east, then broken to pieces and scattered along the tornado track to the north-east for more than a mile. The members of the household, consisting of father, mother, and four children, ran outdoors as the storm came. They first turned north-west, but, thinking that the tornado was coming towards them, they turned towards the east. One by one they were caught up and carried by the wind. The father and baby were carried 150 yards into a field to the north-east, and found in the agonies of death. The mother was carried eastward seventy-five yards, and dashed against a tree, around which she

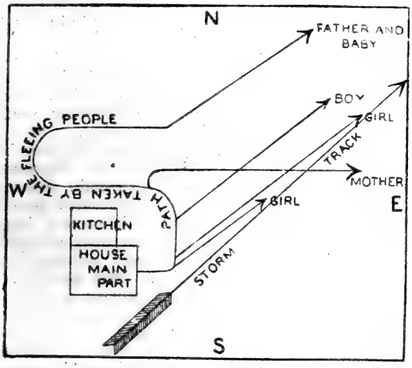


FIG. 2.—Tornado, May 30, 1879. From the Quarterly Journal of the Royal Meteorological Society.

was partially twisted; her skull was crushed, and her clothing was stripped from her body. A girl was found dead, fifty yards north-east of the house, in the direct path of the storm. A boy was blown into a haystack forty-five yards to the north-east, and a girl was found eighty yards to the north-east lying in the tornado track. Neither of these two children was seriously injured. Disasters similar to this one come all too frequently in the American tornado belt.

Finley listed some 600 tornadoes, of which forty were fatal to human life, causing a loss of 466 lives and injuring 687 persons.[3] In the case of the St. Louis tornado (May 27, 1896) the loss of life was 306. In fact, in this one storm the fatalities and the damage to property were greater than in any other single tornado on record. Prof. Mark W. Harrington, formerly Chief of the U.S. Weather Bureau, estimated that the chance that a tornado may, in any year, cross the particular locality where any individual may happen to be is 1 in 625,000, and "not worth worrying about."[4] The late Prof. Cleveland Abbe concluded that even in the so-called "tornado States" the probability of tornado destruction is less than that of lightning or fire.[5]

Distribution of Tornadoes in Place and Time.—The real home of the tornado is over the great lowlands east and west of the Central and Upper Mississippi and of the Lower Missouri valleys, and, to a less marked degree, over some of the southern States. Tornadoes are rare west of the 100th meridian, and very rare or unknown in the mountain areas. They have been reported from all States east of the plains, but decrease markedly in frequency towards the north. They are rare in the Appalachian Mountains, and also infrequent along the Atlantic and Gulf coasts. The widespread impression that tornadoes are increasing in number in the United States is without foundation of fact. Tornadoes are reported with greater accuracy than formerly, and they are likely to do more damage than they used to do because the country is more densely populated.

Tornadoes may appear in any month, and at almost any hour of the day or night. Like thunderstorms, however, they distinctly prefer the warmer months, and the hours closely following the warmest part of the day. Thus spring and early summer (April–July) and 3–5 p.m. are their favourite times.

Tornado Weather Types.—Tornadoes have much in common with thunderstorms. In fact, they are, in reality, special local developments, of greater violence, in connection with severe thunderstorms. The general conditions which produce these two phenomena are, to a large extent, identical. The essential difference comes in the formation of the vorticular whirl in the tornado. Thus, like the largest and most severe American thunderstorms, tornadoes occur as attendants of the parent cyclones of which they are the offspring. They are born, in the large majority of cases, in the area of warm, damp southerly winds flowing northward from the Gulf of Mexico in front of a general cyclonic storm. This storm is usually more or less elliptical or **V**-shaped, its major axis extending north to south or north-east to south-west from the Great Lakes, across the central lowlands well into the southern States. The "wind-shift line" or "critical axis" is usually well marked. North and west of the wind-shift line northerly to westerly winds are blowing, with relatively low temperatures, and not infrequently with rain or snow. South and east of the critical axis there is a great flow of southerly or south-westerly winds with higher temperatures, usually sultry and oppressive weather, and often with rain squalls. When conditions are favourable, tornadoes are likely to occur in a district some 300, 400, 500, or more miles to the south-east, south, or south-west of the cyclonic centre, near, but usually to the east of, the wind-shift line. Here the contrast between the warm, damp southerly and the cool, dry northerly and westerly winds is sharp. Here is inevitably a zone of great disturbance; of over-running, under-running, and mixing; of turbulence; of instability; of local whirls. Here, aided by the local warming due to sunshine, are favourable conditions for breeding thunderstorms and, fortunately much less often, for developing tornadoes. The parent cyclone may travel many thousands of miles, a good part of the way round the world, yet in only one portion of its long course, in the Mississippi valley region of the United States, and usually only at one time of the year, in spring and summer, is just the right combination of conditions attained for developing the dreaded tornado. The

[2] J. P. Finley, "Report of the Tornadoes of May 29 and 30 in the States of Kansas, Missouri, Nebraska, and Iowa," Professional Papers, U.S. Signal Service, No. iv. (Washington, D.C., 1881.)

[3] J. P. Finley, "Report on the Character of Six Hundred Tornadoes," Professional Papers, U.S. Signal Service, No. vii. (Washington, D.C., 1884.)

[4] M. W. Harrington, "About the Weather," p. 164. (New York, 1890.)

[5] Cleveland Abbe, "Tornado Frequency per Unit Area," *Monthly Weather Review*, vol. xxv., p. 250. (Washington, D.C., June, 1897.)

accompanying figure (Fig. 3) is a freehand composite illustration, showing in a broadly generalised way a weather map characteristic of tornado occurrence in the Central Mississippi valley region of the United States. Tornadoes also spring up under conditions which differ considerably from those here illustrated. It is, therefore, impossible to select or to draw any fixed "tornado-type" map.

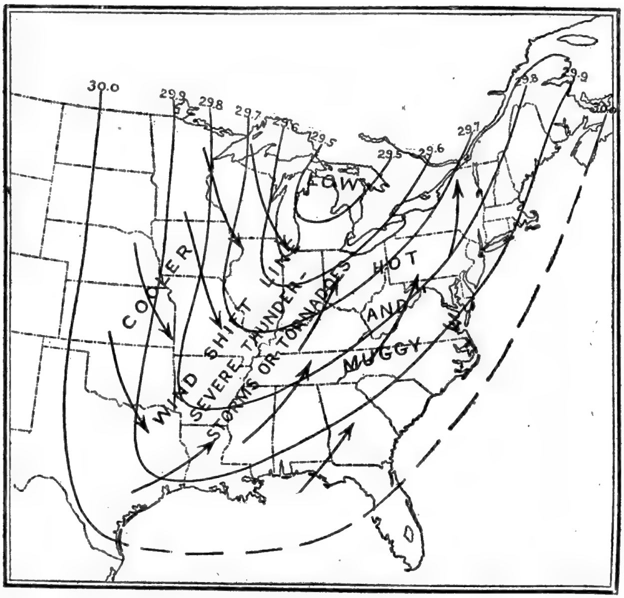


FIG. 3.—Composite weather map, showing conditions favourable for tornadoes R. DeC. Ward). From the Quarterly Journal of the Royal Meteorological Society.

Protection of Life.—The possible protection and preservation of human life in tornadoes are very real and vital questions over large areas of the United States. From a long and intimate study of tornadoes Finley deduced certain rules for the protection of life which have over and over again proved their accuracy and value. If a tornado is approaching, from west or south-west, and the observer is on or very near its probable path, the best thing to do, if there is time, is to run *north*. "Dug-outs" or tornado-cellars should be provided near the house. The safety secured by means of "dug-outs" is that they remove persons who seek refuge in them from risk of injury from flying *débris*, also from the danger of being picked up by the winds.

If there is no time to escape, or if escape is impossible, the safest place is to stand, face forward, against the west or south wall of the cellar, as near the south-west corner as possible. The reason for these precautions is this: that the *débris* of the house will, if the building is destroyed, be most likely to be carried towards the north-east. Hence north-east or east rooms and walls are least safe. If caught outdoors, and otherwise unable to escape, the best thing to do, as a last resort, is to lie flat on the ground in an open space, face downwards, the head to the east, and the arms placed over the head for protection.

Protection of Property: Tornado Insurance.—In regard to the protection of property certain things are fairly clear. Tornadoes cannot possibly be prevented; and no building, certainly none of any practical use, can be built to withstand the violence of the wind in the vortex of a well-developed tornado. Hence the only resource left is to protect life and property to the best of our ability and with a knowledge of the facts which have been brought to light by a sane, unprejudiced, scientific study of the phenomena. Owing to the varying intensity of tornado violence and of the velocity of the surface winds, the damage done to different sorts of buildings varies greatly. If the intensity of the storm is not sufficiently great to destroy everything in its path, the damage done by the less violent winds will obviously depend largely upon the strength of construction and upon the building materials. It was Finley's advice to build "as you would without the knowledge of a tornado." He found, however, that, other things being equal, a frame building seems to resist destruction better than one of brick or stone. The modern steel-construction buildings have some of the "elastic" quality which renders frame structures safer than the more stable and solid ones of stone or brick of the older style. It makes little or no difference in the end whether a building is in a valley or on a hill.

In view of the property loss occasioned by tornadoes it is natural that tornado insurance has become a widespread and popular method of financial protection. So far, however, the business has not been carried on upon a thoroughly scientific basis. Tornado insurance to the amount of several hundred millions of dollars is carried, largely by general fire insurance companies and partly by local mutual insurance companies. The definition of a tornado is usually crude and unscientific, and there is much unnecessary confusion. It is true that the more conservative companies do prohibit some "risks," such as windmills, old and frail buildings, large plate-glass windows, and the like. It is interesting to note the marked rise and fall of the amount of tornado insurance with the occurrence in any year of severe or destructive tornadoes. Closely following the St. Louis tornado of May, 1896, there was an increase of tornado insurance of nearly 10,000,000 dollars, and after the Omaha (Nebraska) tornado of Easter Sunday, 1913, several million dollars' worth of tornado insurance was written in Omaha and the surrounding districts, which were at once thoroughly canvassed by insurance agents. Many new "dug-outs" and cellar caves were built at the same time. As Prof. H. E. Simpson [6] has pointed out, tornado insurance risks differ from others in several ways, notably in the fact that there is no criminal hazard present. For people cannot remove, or explode, or destroy their buildings for the sake of the insurance on the plea that the damage was done by a tornado. It is obviously wise to scatter tornado risks across, not along, the usual path followed by tornadoes.

[6] H. E. Simpson, "Tornado Insurance." *Monthly Weather Review*, vol. xxxiii., pp. 534–39. (Washington, D.C., December, 1905.) (A short bibliography is appended.)

The complete destruction often caused by a single tornado makes it extremely unsafe for any local mutual insurance company to insure over a small area only, where the loss occasioned by one tornado may ruin the company. On the whole, general tornado insurance in the "tornado belt," and buildings erected without regard to the possibility of tornado occurrence, seems to be the best policy. The present status of tornado insurance in the United States is an excellent illustration of the mistakes which are made when thoroughly well established scientific facts, which are easily accessible to the public, are disregarded.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Education Bill was read for a third time in the House of Commons on July 16, and will be considered at once in the House of Lords. It is expected that the Bill will be passed into law before the Parliamentary recess.

BY the will of the late Lord Rhondda the governing body of Gonville and Caius College, Cambridge, will receive out of the residue of his estate the sum of 20,000*l.*, to be applied at its discretion for the benefit of the college, but preferably in the establishment and maintenance of six to ten scholarships tenable at the college for mathematics, natural science, or moral science (including economics), preference being given, *ceteris paribus,* in the awarding of such scholarships to residents or sons of residents in Wales or Monmouthshire.

THE Industrial Reconstruction Council has arranged a series of lectures to be given at the Saddlers' Hall, Cheapside, October to December next. The lectures will be as follows:—"Commerce and Industry after the War," Sir Albert Stanley (President of the Board of Trade); "Principles of Reconstruction," Dr. Christopher Addison (Minister of Reconstruction); "Functions of the Government in Relation to Industry," Mr. W. L. Hichens (managing director, Cammell, Laird, and Co.); "International Trade," Sir Arthur Steel-Maitland (Department of Overseas Trade); "Labour and Industrial Development," Mr. Ernest J. P. Benn (chairman, Industrial Reconstruction Council); and "Science and Industry," Sir William S. McCormick (Department of Industrial and Scientific Research).

THE report of the librarian of the Congress of the United States for 1917 gives a full account of the progress of this great library. A grant of no less than 676,714 dollars was provided for the institution by Congress. The library now contains more than 2½ million volumes, besides manuscripts, maps and charts, music, and prints. Among other valuable acquisitions it contains the largest, most readily accessible, best catalogued, and most used collection in America of Chinese books. Large additions have been made to the valuable library of music. Great stores of materials for the study of social history have been brought together, including both ancient and modern political documents, such as those of Mr. Bancroft Davis, Israel Washburn, and others. The collections are splendidly housed, and the work of arrangement and cataloguing is in active progress.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, June 19.—Mr. G. W. Lamplugh, president, in the chair.—Sir Douglas **Mawson**: Some features of the Antarctic ice-cap. The ice-mantle of the south formerly involved the sub-Antarctic Islands, Patagonia, southern New Zealand, and the higher mountains of Tasmania and of the neighbouring portions of Australia, but it retreated to its present confines—a circumpolar continent—at a time apparently concurrent with the disappearance of the extensive Pleistocene ice-sheets of the northern hemisphere. The existence of a great land mass situated on the face of the globe just where the sun's rays fall most obliquely has the effect of intensifying the polar conditions. This result is achieved by reason of the elimination of the ameliorating influence of the ocean and as a result of the acceleration of the circulation of the moist atmosphere from the surrounding sea to the land, owing to the wide difference in temperature pertaining over the one and the other. Thus the presence of extensive land at the Pole, in contradistinction to ocean, results, under present cosmical conditions, in increased refrigeration, and consequently in greater extension of the polar ice-cap. This, in turn, reflects on the average temperature of other regions of the globe, for an ice surface absorbs but a relatively small proportion of the sun's radiant heat. The existence of the Antarctic continent must therefore have some bearing on the climate of the northern hemisphere, and be reckoned with as a factor contributing to the refrigeration thereof. The shelf-ice formations, including the Ross Barrier and the Shackleton Shelf, were specially referred to; mention was made of their growth and decline, of a method of determining their depth below water, and of the probability of specialised life existing beneath such formations.

Physical Society, June 28.—Prof. C. H. Lees, president, in the chair.—I. **Williams**: A new method of measuring alternating currents and electric oscillations. The method consists of the application of the Crookes and Osborne Reynolds radiometers to the measurement of the R.M.S. values of electric currents. Two types of apparatus are described. In the first of these the heat generated by the passage of the current through a microhm resistance causes the deflection of a light mica vane attached to the extremity of a suspended beam. In the second type the deflection of a fine fibre is employed. Tables and curves are given connecting the indications of the instruments with the current and with the degree of evacuation.—Prof. E. H. **Barton** and Miss H. M. **Browning**: Demonstration of coupled vibrations. The apparatus shown consisted of a pair of pendulums, each of which was suspended from the mid-point of a sagging string, the direction of which was transverse to the direction of oscillation of the pendulums. The two sagging strings were connected by a light wooden rod at the points from which the bobs were suspended. Each bob consisted of a metal funnel, from the apex of which a fine stream of sand fell during an experiment. A horizontal board could be moved slowly on rails just below the oscillating bobs, and the fine sand falling on this gave curves showing their motion. When one bob is set in oscillation, the other being initially at rest, the latter, as is well known, starts to vibrate with gradually increasing amplitude until the first bob has been brought to a standstill, when the process is reversed. From an examination of the equations of motion it is found that the amount of sag in the transverse strings governs the degree of "coupling" of the oscillators, and by varying this, and also the relative mass and periods of the pendulums, curves can be obtained illustrating all the phenomena of coupled electrical oscillations. By stopping one of the bobs when it has just been reduced to rest, thereby preventing the energy from being re-absorbed by it, the conditions of the quenched spark can be imitated.

PARIS.

Academy of Sciences, July 1.—M. Léon Guignard in the chair.—G. **Bigourdan**: The observatory of Godin, Fouchy, and de Bouguer: its co-ordinates.—M. **Hamy**: The determination of radial velocities with the objective prism.—G. **Charpy**: The influence of forging and rolling (*corroyage*) on the mechanical properties of steel. It is generally accepted that cast-steel ingots must be forged or rolled hot until the final section is reduced to between one-third and one-fourth the original section. This involves a considerable expenditure of fuel and labour, and experiments are given by the author which suggest that this hot working does not really improve the metal; the strength is increased in one direction, but reduced in another.—M. Trabut was elected a correspondant for the section of rural economy in succession to the late M. Yermoloff.—J. **Andrade**: A family of displacements and a generalisation of the dihedron.—P. **Humbert**: Two polynomes associated with the polynomes of Legendre.—C. **Raveau**: Thermodynamics based entirely on Carnot's principle. A second absolute temperature.—Ed. **Chauvenet** and Mlle. H. **Gueylard**: The combinations of neutral zirconyl sulphate with some alkaline sulphates. From thermochemical measurements the existence is indicated of the double salts $[(ZrO)SO_4]_3.2Na_2SO_4$ and $[(ZrO)SO_4]_3.2(NH_4)_2SO_4$, together with the two corresponding containing $7H_2O$.—A. **Valeur**: The presence of a non-volatile alkaloid in the broom (*Sarothamnus scoparius*). This new alkaloid was isolated from the last mother liquors obtained in the successive crystallisations of commercial sparteine sulphate, and the name sarothamnine is suggested. Its formula is given provisionally as $C_{15}H_{24}N_2$, isomeric with the base spartyrine resulting from the gentle oxidation of sparteine.—Mlle. Yvonne **Dehorne** and L. **Lutaud**: Tectonic observations on the neighbourhood of Martigues (Bouches-du-Rhône).—F. X. **Skupienski**: Sexuality in the Myxomycetes.—R. **Souèges**: The embryogeny of the Liliaceæ. Development of the embryo in *Anthericum ramosum*.—M. **Folley**: Technique of blood transfusion.—P. L. du **Noüy**: A general equation for the law of normal cicatrisation in surface wounds.

CAPE TOWN.

Royal Society of South Africa, May 15.—Dr. J. D. F. Gilchrist, president, in the chair.—Ethel M. **Doidge**: South African Perisporiaceæ. III. Notes on four species of Meliola hitherto unrecorded from South Africa. The fungi considered in the paper are all from Natal and the eastern part of the Cape Province, and have been identified from recent collections.—J. D. F. **Gilchrist**: Reproduction of fishes in Table Bay. The eggs and young of twenty-one species of fishes were procured in about sixty tow-nettings made at more or less regular intervals throughout the year. Fourteen of these were referred to known species. The eggs procured and larvæ hatched from them are described and figured. The eggs of the sardine (*Sardina sagax*) and of the anchovy (*Engraulis capensis*) indicate that these fish are present in abundance, though as yet not utilised for economic purposes.—W. A. **Jolly**: Note on the electrogram of the medulla oblongata.

BOOKS RECEIVED.

Chemical Combination among Metals. By Prof. M. Giua and Dr. C. Giua-Lollini. Translated by G. Wooding Robinson. Pp. xiv+341. (London: J. and A. Churchill.) 21s. net.

Papers for the Present. Second series, No. 4. The Re-education of the Adult. The Neurasthenic in War and Peace. The Convalescent as Artist-Craftsman. Pp. iv+19. (London: Headley Bros., Ltd.) 6*d*.

Telegraphy, Aeronautics, and War. By C. Bright. Pp. xvii+407. (London: Constable and Co., Ltd.) 16*s*. net.

Life and Letters of Sir Joseph Dalton Hooker, O.M., G.C.S.I. Based on materials collected and arranged by Lady Hooker. By L. Huxley. 2 vols. Vol. i., pp. x+546. Vol. ii., pp. vi+569. (London: J. Murray.) 36*s*. net.

The Recovery and Re-manufacture of Waste Paper. A Practical Treatise. Printed on paper made entirely from regenerated waste paper. By J. Strachan. Pp. vi+158. (Aberdeen: The Albany Press.) 12*s*. 6*d*. net.

Report on the Danish Oceanographical Expeditions, 1908–10, to the Mediterranean and Adjacent Seas. Published under the superintendence of Dr. J. Schmidt. Vol. ii. Biology. No. 4. Pp. 1–154+1–28+1–40+1–15. No. 5. Pp. 1–154+1–70+1–18+1–20. (Copenhagen: A. F. Høst and Søn.)

The Zinc Industry. By E. A. Smith. (Monographs on Industrial Chemistry.) Pp. viii+223. (London: Longmans, Green, and Co.) 10*s*. 6*d*. net.

The Commonwealth Book of Cookery. By M. V. Palmer. Pp. 124. (London: Longmans, Green, and Co.) 2*s*. 6*d*. net.

The Modern Treatment of Mental and Nervous Disorders. A lecture delivered at the University of Manchester on March 25, 1918. By Dr. B. Hart. Pp. 28. (Manchester: At the University Press.) 1*s*. net.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, JULY 25, 1918.

SCHOOL AND COLLEGE MATHEMATICS.

(1) *Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, for the Years* 1908–17. Edited by R. M. Milne. (London: Macmillan and Co., Ltd., 1918.) Price 7s.

(2) *A Short Course in Elementary Mathematics and their Application to Wireless Telegraphy.* By S. J. Willis. Pp. 173. (London: The Wireless Press, Ltd., 1917.) Price 3s. 6d. net.

(3) *Infinitesimal Calculus.* By Prof. F. S. Carey. Section i. Pp. xiii+144+Answers v. Price 6s. net. Section ii. Pp. x+145–352+Answers iv. Price 10s. 6d. net. (London: Longmans, Green, and Co., 1918.)

(1) THIS collection of examination papers will be found useful by many teachers and students, even if their work is not immediately associated with the requirements of the military authorities. The papers for the Army Qualifying Certificate include questions on more advanced arithmetic, elementary algebra and geometry, mechanics, and a little trigonometry; special attention is paid to practical methods and applications. The papers for admission are wider in scope and more difficult in character. The mathematics is divided into three parts. The elementary papers are of a practical nature, involving principally drawing and mensuration. The intermediate papers are also practical, and include mechanics, besides some algebra, geometry, and trigonometry. The higher papers introduce in addition easy differentiation and integration. The questions are very skilfully devised, and many teachers and examiners would benefit by a perusal of this volume.

(2) Mr. Willis has written an eminently useful exposition of the mathematics required by the student of wireless telegraphy. To use the language of the accompanying advertisement, the book does not presume that the student is unable to add two and two together, nor does it plunge into advanced work for which the student is quite inadequately prepared. There are chapters on logarithms and the slide rule, practical geometry and mensuration, including a little on conic sections, equations and progressions, the fundamental ideas and formulæ of trigonometry, vectors with examples from statics and dynamics, and an excellent chapter on the "use of squared paper" with the beginnings of differentiation. Many examples are worked in full, others are set as exercises. The volume concludes with some useful tables.

The author's style is very pleasant and persuasive, and the book is one that can be safely recommended for the purpose for which it was written. A few typographical criticisms must, however, be offered. The base of Napierian logarithms is written differently in different places, and dashed letters are sometimes written a^1, b^1; this is quite inexcusable when dashes are used in the figure and "ones" in the accompanying text. Some of the conics are badly drawn. The notation used is sometimes confusing; surely no student should be encouraged to write: "Thus the series is a G.P. in which $a=a/2x$. . . ."

With regard to the mode of treatment, we would like to suggest that the elaborate investigations on the factors of quite simple quadratic expressions are unnecessary, and that the order of treatment is a little unsound pedagogically.

(3) Prof. Carey's book can be heartily approved as a compact and clear statement of practically all that the ordinary student of the infinitesimal calculus "as an instrument in the attainment of further knowledge" is likely to require. Section i. deals with the more elementary parts of the subject, including the theory of limits, easy differentiation and integration, and applications to curves, areas, volumes, etc. Section ii. proceeds to the advanced parts of the subject, and discusses, *inter alia,* definite integrals, polar and other properties of curves, and the important types of differential equations. The author has evidently kept in mind all through the practical application of the methods and results, as is indicated by the references to problems in mechanics and physics. A short chapter on graphical methods includes a brief account of nomography, a graphical process which is gaining currency in this country owing partly to the intimate relations now existing between our engineers and their French and American brethren.

Whilst we welcome the commendable brevity of the book, we cannot but express the fear that the author has attempted to cater for too wide a range of students. The first section is far too difficult to be accepted as corresponding with "the syllabus of some examinations for higher school certificates." Much of the contents of the chapters dealing with the notion of a function, limits, and continuity should come at the end of a first course on the subject, rather than at the beginning.

The main ideas of the calculus must be based at first on geometrical intuition, and this is recognised by the author, who has given many illustrations of the processes by means of curve plottings. We should have welcomed a similar treatment of differential equations. Instead of this we have the traditional series of tricks for the solution of selected types. It is to be hoped that before long the student of mathematics will be taught this branch of the subject by methods more in accord with recent developments. Perhaps it was also lack of space that caused excessive compression of the treatment of this and other branches. The references to nomography, for example, would have been far more valuable if space had been spared for a fuller discussion of the underlying principles.

The book is well printed and neatly produced. An exception to the general excellence is to be found in the diagrams, many of which are not well drawn. We hope that in a future edition care will be taken to remedy this and some other minor defects.

There is one statement that we feel cannot be accepted without some consideration: "If a man ever scales 9 stone there must have been a time at which he weighed $4\sqrt{5}$ stone." Is this necessarily so?

S. B.

LECITHIN AND ALLIED SUBSTANCES.

Lecithin and Allied Substances: The Lipins. By Dr. H. MacLean. ("Monographs on Bio-chemistry.") Pp. vii+206. (London: Longmans, Green, and Co., 1918.) Price 7*s.* 6*d.* net.

THE time had come when an account of the chemistry of lecithin and allied substances should be written and must be read by everyone interested in bio-chemistry. Ten years ago it had not. At that time the subject could only have been presented as an unprofitable series of disputes on insecure premises. Now there must be many for whom this monograph will be a revelation, many who, though they may have read, have not collated the important contributions to the elucidation of this most difficult subject that have appeared in the last few years, and who, when they see this done admirably, as it is done here, will realise that a new epoch in the history of bio-chemistry is being marked out.

It is just ten years since Dr. MacLean published the first of a series of papers in which, starting from the fact that the amount of choline obtained in the hydrolysis of lecithin was always less than the supposed structure of this substance required, he established good ground for his belief that this is due to the fact that lecithin, as ordinarily obtained, is mixed with kephaline, in which, as we know now from the work of Parnas and his associates, the basic group is aminoethanol. Dr. MacLean has described a method of purifying lecithin, so that it gives the theoretical yield of choline, and, therefore, is free from kephaline. Other impurities that are associated with lecithin which he can by his method remove may, indeed, so disguise it as to make it appear as some one or other of those vague phosphatides of which too many have been described, and of which we are told little but that they are soluble in this and insoluble in that solvent, and contain nitrogen and phosphorus in a certain proportion. Lecithin and kephaline now mean something more than this.

Then from the limbo of protagone there have emerged sphingomyelin and the cerebrosides, with their common basic component sphingosine, substances that forty years ago Thudicham had seen before their day had come. In the last few years the work of Thierfelder, of Rosenheim, of Lapworth, and, above all, of Levene, who, to the advantages of a richly endowed institution, has added the enthusiasm and the patience of a great investigator—work that has finality—has given to these somewhat ghostly shapes reality and precision of outline. This work on the constitution of sphingosine and on the strange fatty acids of sphingomyelin and the cerebrosides confers on these substances a living interest, now that their chemical structure is acquiring definition, as great as that which has been focussed, for instance, on the nucleic acids or on hæmatine. In all there are the same elements of novelty, mystery, and wealth of biological significance. Dr. MacLean is to be congratulated on his opportunity no less than on the use he has made of it.

It was no doubt unavoidable that this book, coming just when it has, should still contain, in addition to the chapters describing the advances of recent years, whole sections devoted to the unwelcome task of pronouncing judgment on so many substances, named and unnamed, the discovery of which has not been established. Dr. MacLean would probably, too, have preferred not to have had to commit himself in the matter of nomenclature. The things that count have good enough names. Lecithin, sphingosine, and sphingomyelin are appropriately and successfully named, though it is true as much cannot be said for kephaline, phrenosine, or kerasine. Schematic nomenclature matters less, and it is in this that agreement has not been attained. When the subject reaches the schools this will be added to it.

A FAUNISTIC SURVEY.

The Invertebrate Fauna of Nottinghamshire. By Prof. J. W. Carr. Pp. viii+618. (Nottingham: J. and H. Bell, Ltd., 1916.)

THE Nottingham Naturalists' Society is to be congratulated on having produced a finely executed survey of the invertebrate fauna of the county. It is part of a survey which was resolved upon when the society completed its fiftieth year, the task being placed in the competent hands of Prof. J. W. Carr. He has been efficiently helped by collectors and by specialists, and it is satisfactory to read that "practically every species recorded has been submitted to and named by a leading authority in the group to which it belongs." The whole work shows a high standard of carefulness, and it will be of great service to active local naturalists, who have now an authoritative list to which they may add. That there are many additions to be made is plain when we look at the sparseness of the records as regards Nematodes, Rotifers, Leeches, and some other classes.

Among the excellent features of this "Fauna" we may mention (1) the precision which so often marks the record of the particular kind of environment frequented by a particular species, and (2) the insertion of introductory descriptions of phyla, classes, orders, and sometimes even families. They are tersely and clearly phrased, and greatly increase the value of the lists. The consistent use of different type-founts for the various grades of classification from phylum to species is another instance of carefulness, and the whole typography is excellent. As data accumulate, the indefatigable editor proposes to append supplements, and already there are nearly 300 additional species of Diptera waiting for admission. The Vertebrate

Fauna and the Flora will be dealt with in separate volumes. We are glad to know that along with the published records there is growing up a local collection of actual specimens—in short, a regional survey museum. For these "Faunas" and "Floras" are not appreciated at their highest value when considered by themselves; their larger importance is as components of an integrated survey; and those who may think that we are saying too much about a book consisting mainly of careful records of the finding of hundreds of spiders, insects, molluscs, and worms have yet to understand that one of the factors in secure progress must be—more than heretofore—an intimate and scrupulously accurate survey of all the facts of every region.

OUR BOOKSHELF.

A Handbook of Briquetting. By Prof. G. Franke. Translated by F. C. A. H. Lantsberry. Vol. ii., *Briquetting of Ores, Metallurgical Products, Metal Swarf, and Similar Materials, including Agglomeration.* With Appendices. Pp. xi+214. (London: C. Griffin and Co. Ltd., 1918.) Price 15*s*. net.

The promised second volume of the translation of Prof. G. Franke's work on briquetting has now appeared, dealing with the briquetting of materials other than fuels. These materials are, first and foremost, iron-ore, to which the greater part of the work is necessarily devoted; next flue-dust and certain other metallurgical by-products; and, finally, metallic borings and turnings, which the translator is pleased to designate "swarf." The work is distinguished by the same amount of careful detail, particularly in the description of the mechanical appliances, that characterised the first part, but it is evident that the author has not the same practical familiarity with this portion of his subject as he displayed in dealing with fuel in his former volume. Much of his information is derived from current literature, and is neither so complete nor so accurate as it was in the case of coal. His handling of the important subject of the briquetting of iron-ores is far inferior, for example, to the paper on the same subject read before the Iron and Steel Institute last autumn by Messrs. Barrett and Rogerson. For instance, the list of Swedish briquetting works given by the author refers only to the year 1906, and is now hopelessly out of date. Still worse is the total omission of the entire group of modern sintering processes, such as the Dwight-Lloyd, Huntington-Heberlein, Greenawalt, etc., which are generally looked upon as the most promising of any of the methods hitherto devised for treating iron-ores. It cannot be denied that these defects rob the work of much of its value, though anyone desiring detailed accounts of the older methods will find them given very fully.

As regards the translation, it is possibly an improvement on that of the first volume, but still leaves very much to be desired.

State Geological and Natural History Survey. (State of Connecticut. Public Document No. 47.) Vol. v., Bulletin 22. *Guide to the Insects of Connecticut.* Part iii. *The Hymenoptera or Wasp-like Insects of Connecticut.* By H. L. Viereck, with the collaboration of A. D. MacGillivray, C. T. Brues, W. M. Wheeler, and S. A. Rohmer. Pp. 824+plates x. (Hartford: Printed for the State Geological and Natural History Survey, 1916.)

Collectors and observers of insects in New England are fortunate in having at their disposal such a "guide" as this to lead them in the discrimination of genera and species in that most fascinating, but systematically most difficult, order, the Hymenoptera. Some of the most eminent of American entomologists have collaborated in the production of this volume, and their careful diagnoses and analytical tables are rendered the more comprehensible to the beginner by clear structural text-figures. As very many genera are common to both the western and eastern continents, this book will be of value to European workers, who will be interested to find that not a few of the Connecticut species of ants, wasps, and bees are identical with familiar British insects. Although the treatment is predominantly systematic, information on the habits of many of the families is furnished, and the plates illustrating gall-forming and nesting activities are instructive. Good line-drawings would have been preferable to the photographic reproductions of museum specimens of insects, many of which are badly set and some mutilated. The great merit of the book consists in its presentation of the modern classification of all the families and the more important genera of Hymenoptera in a single, if somewhat bulky, volume. G. H. C.

The Baby. ("Manuals of Health," ii.) By Dr. S. Seekings. Pp. 63. (London: Society for Promoting Christian Knowledge, 1918.) Price 9*d*. net.

We do not find anything particularly novel in this little book on baby management, nor does it seem to present anything that cannot be found in several other books of a similar type. It is written clearly and simply, and the directions can be easily followed. For artificial feeding it is recommended that the milk be always scalded, but no direction is given on the importance of cooling in hot weather. In the chapter on common ailments (or elsewhere) we find no mention of vaccination and the treatment of the arm, while, though comparatively infrequent in the infant, measles and whooping-cough are discussed. It is stated that measles causes more deaths among children under a year old than at any other age. This is incorrect: almost twice as many children die in their second year from this cause as in the first year, and the measles death-rate in the second year is nearly eight times that in the first year. Some useful directions are given in an appendix for the preparation of barley and albumin water, etc., and for knitting infants' garments. 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.]*

Discovery of Neanderthal Man in Malta.

OF the various problems relating to extinct forms of man, none is of greater interest than that which concerns *Homo neanderthalensis*. This peculiar and extinct species of man appeared in Europe about the commencement of the Mousterian cultural period, and all traces of him vanish towards the close of that period. Where he came from and where he finally disappeared we do not know, hence every additional fact we can collect about him is of value. So far his remains have been found at Gibraltar (1848), the Rhine valley (1857), Belgium, the Dordogne, and Croatia. The peculiar teeth of this race were reported from the Mousterian strata of a cave in Jersey by Dr. R. R. Marett in 1911. Excavations in the cave of Ghar Dalam, in the south-eastern corner of Malta, carried out by Dr. Giuseppe Despott, curator of the Natural History Museum of the University of Malta, working for a research committee of the British Association, has brought to light the remains of Neanderthal man in that island, thus extending the distribution of this species to another continent; for, in a zoological sense, Malta is African rather than European. It is true that so far only two teeth have been found—a first upper molar and a milk molar—but those who are familiar with the characteristic form of the molar teeth of Neanderthal man will have no hesitation in assenting to the truth of Dr. Despott's discovery. I append Dr. Despott's photograph of the two Neanderthal teeth, giving for comparison photographs of the teeth of a modern type of man found in the Neolithic strata of Ghar Dalam, overlying the strata from which the Neanderthal teeth were derived (Fig. 1).

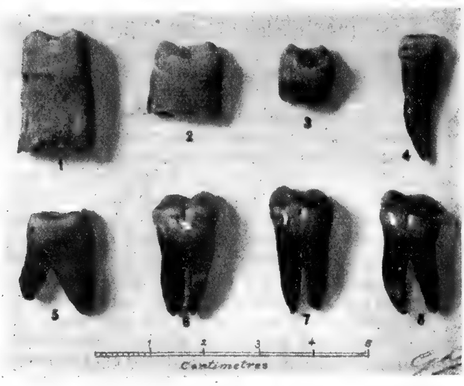


FIG. 1.—Teeth from Ghar Dalam. (1) Upper Neanderthal molar; (2) upper Neanderthal milk molar; (3) milk molar from Neolithic strata; (4, 5, 6, 7, 8) other teeth from Neolithic strata.

A brief history of the discovery is as follows:—In 1914 Section H (Anthropology) of the British Association appointed a research committee to carry out archæological investigations in Malta, Prof. J. L. Myres being chairman, and Dr. T. Ashby, of the British School of Rome, secretary. Dr. Ashby, in partnership with Dr. Zammit and Dr. Despott, commenced to investigate Ghar Dalam, a cave more than 700 ft. in length, with a width of 26 ft. to 60 ft., and strata in its floor running down to a depth of 12 ft. or more. In 1917 Dr. Despott, with the aid of a further sum of 10*l.* granted by the British Association, continued the investigations for the committee in July and August, 1917. Two trenches were dug across the floor of the cave—one 50 ft. from the mouth, the other 60 ft. further along. The strata encountered will be seen from a drawing given by Dr. Despott in his report for 1916. The upper two layers indicated

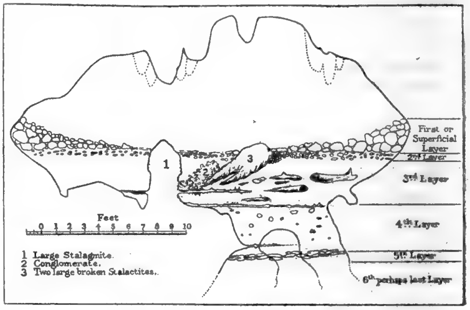


FIG. 2.—Section of the strata of the floor of Ghar Dalam.

in the plan yielded remains of animals and pottery of the Neolithic period. The third layer yielded remains of the stag, a vole, a variety of snail (*Helix vermiculata*, var. *despottii*), and human remains—the first upper molar of *Homo neanderthalensis*; the other human bones have not yet been studied. In the same stratum and at the same level as the human remains were found a flint scraper, three obsidian scrapers, a chert knife, and a piece of apparently worked chert. At another site in the same stratum was found part of a fine flint knife, which Sir Hercules Read regards as of late Cave period in workmanship.

The milk molar of Neanderthal man came from the next layer—the fourth in the appended section (Fig. 2). In this stratum were found the remains of stag (apparently two species), plentiful remains of the extinct elephant (*Elephas mnaidrensis*), the fossil tooth of a shark, worn and chipped at the point by being used as a tool, and mollusc shells which had apparently been opened and their contents extracted by ancient man. Still deeper strata yielded numerous remains of three extinct elephants (*E. mnaidrensis*, *E. melitensis*, and *E. falconeri*), two species of hippopotamus and of the stag. So far traces of man have not been observed in these deeper and older strata.

When the committee of Section H came to consider the report transmitted to it by Dr. Ashby from Malta, it at once recognised the value of Dr. Despott's discovery and the importance of Ghar Dalam as a repository of Pleistocene history. When one considers the extent of the cave, the thickness of its floor, and the fact that every trench so far made has yielded traces of man, it is not too much to hope that we have here a Pleistocene palace of Knossos—a site which is likely to throw the same light on early man in the Mediterranean as was thrown on the Bronze period of that area by the discoveries made by Sir Arthur Evans in Crete. The committee, in recommending the renewal of a grant of 10*l.* for the investigations carried on by Dr. Despott, was well aware of its total inadequacy, but it had to remember that in these times the finances of the British Association have been crippled; the Association has now to draw on its very limited capital. The committee took the view that, as an Imperial people, it is our duty to shoulder our responsibilities and develop the resources of the Empire—resources of knowledge as well as resources of material—in time of war as well as in time of peace. We are too apt to make war an excuse for postponing our immediate duty. Sir Thomas Wrightson, Bart., has given 50*l.*, but it does not seem too much to expect that three other subscriptions of equal amount may be placed at the disposal of the Research Committee for Archæological Investigation in Malta, in addition to the grant from the British Association. The labour conditions in Malta are at present favourable for the continuance of this kind of Imperial undertaking, and the men who are in charge have the skill and experience to employ to the best advantage the modest sum here asked for.

Arthur Keith,
President, Section H (Anthropology) of the British Association.

A Successful Method of Obtaining Amœbæ for Class Purposes.

Zoological departments in all parts of the British Isles have experienced, during the last few years, considerable difficulty in obtaining a good supply of *Amoeba proteus* for class purposes at the proper time, the usual hunting-grounds for this organism failing, for some reason or other, to yield their former abundant supply.

The difficulty was overcome in this department during the present session by making use of amœbæ obtained from soil by a suitable culture method, the outcome of the writer's work on soil protozoa. This method has proved so successful that it has been thought desirable to give a brief account of it, especially as it has come to my knowledge that other zoological departments are desirous of trying it. A somewhat similar method of obtaining amœbæ for class purposes has been in use for some years in the University of California, and has been described by Kofoid in the Trans. Amer. Micro. Soc., vol. xxxiv., October, 1915.

For the cultivation of amœbæ from soil a liquid medium is preferable to a solid one, such as nutrient-bouillon agar, frequently used for amœba cultivation, owing to the fact that one frequently finds on a solid medium amœbæ with two or more nuclei and various other abnormalities not found in amœbæ from a liquid-culture medium.

One per cent. hay-infusion is a very useful medium, and is constantly used here. It is prepared as follows:—Ten grams of chopped hay are put into a beaker or flask with one litre of distilled water, and steamed for about three-quarters of an hour; filter, and then make the filtrate just alkaline by the addition of a sufficient quantity of caustic-soda solution (N.NaOH solution is quite suitable) to make a strip of red litmus paper turn a bluish tint when immersed in the liquid. Sterilise in the autoclave, and, when cold, pour a small quantity into three or four Petri dishes until the liquid is a few millimetres in depth, and inoculate each with soil; about half a gram is sufficient soil for each plate. Almost any kind of soil will serve—garden or field soil.

Put the dishes aside for a day or two, either in an incubator at 20°–25° C., or on the laboratory-table, away from direct sunlight, and then examine under the microscope for amœbæ. The latter are, as a rule, of the *limax* type, and are generally to be found on the surface or at the bottom of the culture.

Ciliates and flagellates will also be found in considerable numbers; in fact, the ciliates frequently predominate in the early days of the culture, and only when they become less numerous do the amœbæ increase in numbers.

For the purposes of examination clean coverslips may be dropped on to the surface of the culture-liquid, and then removed to slides and examined under the microscope; or a platinum loopful or two of the surface layers may be taken and put on a slide and then covered with a clean coverslip. When most of the amœbæ are at the bottom of the culture, as sometimes happens, they are more difficult to remove to slides, but they may be sucked up by means of a capillary pipette gently moved over the bottom of the dish and then transferred to the slide. The coverslips should be sealed with vaseline or wax to prevent evaporation.

The amœbæ vary in size from very small forms, which are not of much service for class purposes, to fairly large forms, which are quite admirable, showing great amœboid activity and revealing clearly under the higher powers of a junior-class microscope the differentiation between ectoplasm and endoplasm, the nucleus, and the streaming of the protoplasm during the progression of the amœba. Such forms may measure anything from $20\,\mu$–$60\,\mu$ in length, according to the degree of extension of the body, and even larger forms may be met with. The organism which has been obtained in practically pure mixed culture here, and has proved so useful, measures between $30\,\mu$ and $50\,\mu$ when extended. The cyst has a diameter of $16\,\mu$–$17\,\mu$.

Having obtained a good-sized form, one should allow it to multiply, and finally to encyst. The cysts may then be picked up by means of a capillary pipette and transferred to fresh culture medium, when one is almost certain to obtain a practically pure mixed culture. Further subcultures can be made by inoculating the cysts into fresh dishes of hay-infusion, and by this means the race may be kept going for months, or even years.

Even if the cultures dry up, and remain dry for a month or two, it will still be found possible to obtain a supply of organisms by scraping some of the brown deposit from the inside of the dish and placing this in fresh sterile hay infusion. After a few days amœbæ will be plentiful, having hatched out of the cysts contained in the deposit from the old culture.

Such a cyst-containing deposit or old culture containing cysts can be kept as a stock, and when active amœbæ are required all that is necessary is to seed a dish or two of hay-infusion with cysts two or three days before the organisms are wanted, and one can be certain of obtaining a good supply of active forms.

I shall be pleased to supply any zoological department with a small quantity of cyst-containing deposit or old culture liquid containing cysts of the form cultivated here in case no success is obtained with the method described above.

T. Goodey.

Department of Zoology, The University,
Birmingham, July 16.

SCIENTIFIC PLANT BREEDING.

So much attention has been directed to the purely scientific advance that has followed the birth of Genetics as a new branch of science that little regard has been paid to the very remarkable results already reached by the application of Mendelian methods to the problems of economic plant production. It is necessary to distinguish somewhat sharply between the facts which Mendel was the first to discover, and the hypotheses which have been put forward to explain these facts. The practical plant breeder is not primarily concerned with the theory of the subject; the Mendelian fact of grand importance to him is that unit characters do segregate, and that new combinations of these characters can be made.

It may be of interest, therefore, to consider some of the more important results obtained in regard to food-producing plants, and to indicate some of the difficulties which may impede future progress. Of food grains none is more important than wheat. The most marked achievement in wheat breeding is the production of a variety resistant, if not entirely immune, to the fungous disease known as Yellow Rust (*Puccinia glumarum*), as a result of the discovery that resistance to this disease obeys the Mendelian law of segregation. Once this was established it became a comparatively simple matter to transfer this character as an independent unit from the poor yielding Russian wheat, "Ghirka," in which it was found, to a wheat suitable to the conditions of England. The variety "Little Joss," which was "made" in this way some ten years ago, is now well established in the Eastern Counties.

The possible economic value of this achievement becomes apparent if the enormous yearly losses caused by rust—perhaps not far short of 10 per cent. of the yield annually—are considered. Another economic character that can be controlled in the same way is stiffness of straw, a matter of importance in those parts of the country, such as the Fens, where a weak-strawed wheat becomes "laid" in wet seasons. It is interesting to learn that a short, stiff-strawed variety known as "Fenman" has recently been produced which is likely to be largely adopted in the Fen country. But the possibility of greater additions to the food supply of the country is now in sight. It is well known that wheat is commonly a slow-growing plant; sown in late autumn or winter, it is harvested in August. Barley and oats, on the other hand, come to maturity more rapidly, and need not be sown until spring. There are, however, certain varieties of wheat which can be sown in spring, but, unfortunately, their yield of grain is considerably less than that given by winter wheats. The result has been that under the ordinary conditions of farming in this country the area that can be sown with wheat is limited to that not occupied by a crop during winter. Barley and oats must be grown after "roots" because the latter are not completely off the ground until early spring. If, then, it were possible to make a spring wheat combining the character of early maturity with a yield approaching that given by winter wheat, the economic gain might be enormous, for, obviously, it would be in the interest of home food production to curtail the area occupied annually by barley. If, then, we could add to the existing acreage sown annually with wheat only one-quarter of the normal acreage under barley and oats, we should add probably 20 per cent. to the home-grown cereals available for human food. The possibility of making an improved spring wheat depends upon how far early maturity and yielding capacity are found to segregate. Apparently, there are indications that the former does, but the problem in regard to the latter is complex, depending for its solution on the clearing up of the difficulties that are encountered in dealing with quantitative characters, such as yield, as distinct from qualitative characters, such as colour of grain.

The questions involved are obviously of great economic importance, for it is the quantitative characters that often determine the economic value of a plant or animal. But it is not simply a question of the universality of the Mendelian law. If, as some geneticists hold, the inheritance of quantitative characters is regulated by a complex of unit characters, the practical application of Mendelian principles becomes exceedingly difficult, for with any number of characters over three the number of possible combinations of unit characters becomes generally too large to handle. And the difficulty does not end there, for, owing to environmental fluctuation, the comparative genetic behaviour of individuals cannot be disentangled, and the plant breeder is consequently driven to resort to purely empirical methods of selection. Nevertheless, the fact that the exact nature of the laws regulating the inheritance of quantitative characters is still obscure may not seriously impede the work of the practical breeder. In fact, it has been found in practice that, provided desirable qualitative characters can be built up in the desired complex, the quantitative characters may be susceptible of improvement by selective methods of a more or less empirical nature.

But when all is said, scientific plant improvement in Great Britain has made only a small beginning, due, no doubt, in part to the general excellence of the varieties of economic plants now established in this country. The "Improvers" of agriculture and horticulture in the nineteenth century revolutionised the industry, and, as an outcome of their activities and influence, British seedsmen, largely by selective methods, effected very great improvements in economic plants. It is only comparatively recently that this country has fallen behind. Allusion may be made to the great advances achieved in Sweden as a result of the work of the Svälof plant-breeding station. Denmark also is forging ahead, but, curiously enough, progress has not been remarkable in Germany, owing, perhaps, to the extraordinary cult of Darwinism which prevails there, and the consequent belief in the effectiveness of mass selection. In America considerable progress has been made from a scientific as well as from an economic point of view—notably in producing a cotton immune to the destructive Wilt disease.

But if a striking object-lesson of the successful application of new methods to plant production is needed we must turn to India.[1] Dating from

[1] Report on the Progress of Agriculture in India for 1916–17. (Calcutta Supt. Govt. Printing, 1918.)

the foundation of the Pusa Research Institute about the beginning of the present century, great developments in the scientific exploitation of Indian agriculture have taken place. Much credit is due to Lord Curzon, who, aided, it is now curious to recall, by the munificent bequest of an American (Mr. Phipps), founded a department which it is no exaggeration to say has added thousands, and will add millions, to the wealth of the country. India undoubtedly presented a fine field for the modern plant breeder. If we consider the immense variety of her plant products, their value either as food or in the arts and industries, and then observe that, owing to the absence of any skilled seed production industry, there is an uncounted number of identifiable races within each distinctive variety of economic plant, we can form some conception of the possibilities which even selection presents: superadding hybridisation, it is difficult to assign any limits to the field that is opening out.

It would be impossible in the ordinary limits of space to give a detailed account of what has already been achieved, but some indication may be given of proved successes in relation to the more important economic plants.

Mention may first be made of Wheat, of which upwards of 30 million acres are grown, and which was naturally one of the first crops to receive attention. Both selection and hybridisation have been brought into action, and several new varieties are now firmly established. In the United Provinces in 1917 alone "Pusa No. 12" occupied 100,000 acres, and was extensively grown in the Punjab as well. This wheat gives a cultivator an *increased yield of 25 per cent.* over the varieties formerly grown by him, as well as nearly one shilling per quarter more on the market, owing to its improved quality. Another and later production of Pusa has on occasions given a yield of nearly fifty-five bushels per acre, which for India is an unheard-of figure, and may be compared with thirty-two bushels, the British average yield of wheat. In the Punjab another new variety occupied 97,000 acres, and it is estimated that the growers of this wheat were presented with an additional income of nearly 15,000*l.* In the Central Provinces improved varieties, returning to the cultivators considerably increased profits, occupied 200,000 acres.

Remarkable progress is also being made in the production of improved varieties of Rice, the most important cereal crop in India. A variety known as "Indrasall," isolated by pure lime selection, occupied 20,000 acres in Bengal. In the Central Provinces it has been necessary to establish thirty seed farms for the production of other new varieties. Turning to non-food products, we find that extraordinary advances have been made in regard to cotton (of which 20 million acres are grown in India). In Surat an improved cotton has been produced giving a premium value of 13 per cent.; in Sind new varieties are giving a premium of 23 per cent. In the Central Provinces a new introduction is estimated to occupy no less than 800,000 acres, and to have brought the cultivators increased profits of nearly 900,000*l.* After this we may pass over such relatively inconsiderable figures as 215,000 acres under a new variety in the Punjab, but, for its human interest, mention may be made of one incident in a campaign directed to the eradication from a certain district of an inferior indigenous variety. It is a good example of the methods adopted to impress the Oriental imagination. "In the Tinnevelly district the department had to resort to drastic action for the control of seed in the case of some ninety acres of *pulichai* [the inferior cotton] . . . the seed from this cotton was publicly burnt . . . before a large gathering of ryots."

In the improvement of Jute (of which India exports annually products worth 40,000,000*l.*) some notable advances have been made. It is expected that in the present year more than 30,000 acres will be sown with a new selected variety as a result of the distribution by the department of 500,000 packets of seed. In this connection a valuable scientific discovery may be mentioned. The pernicious weed, water hyacinth, which infests the waterways of Bengal, has been found to have a high potash content, and is consequently a valuable manure for jute, the use of which not only directly stimulates yield, but also protects the plant against a Rhizoctonia disease which attacks it.

It will be readily admitted that this tale of economic progress is astonishing. No mention has been made of the purely scientific results achieved, and they are very considerable. The workers no doubt feel well rewarded by the satisfaction with which they must regard the additions to knowledge which they have made, but they may also feel some pride in the remarkable economic advances which their labours have brought about, especially in regard to the food-producing plants.

THE VALUE OF INSECTIVOROUS BIRDS.

THROUGHOUT the country at the present time farmers, fruit-growers, allotment-holders, and owners of gardens are faced with a plague of insects such as has not been experienced in the United Kingdom for many years past. True it is that we have had more or less local outbreaks of the winter moth, the cabbage butterfly, apple and plum aphids, wireworms, leather jackets, and numerous other pests of great severity, but not, in the present writer's opinion, to such a general extent as at the present time.

The reason for this very serious state of affairs is not difficult to discover, and although the truth may not be palatable, it is, nevertheless, true that it is largely due to neglect and to an absence of a State Department with a thoroughly practical and scientific staff. It would be futile and unprofitable to dwell upon either of these two causes. Rather let us turn to another phase of the matter not altogether foreign to the subject, viz. the value of our insectivorous birds in controlling insect life.

Whilst no one possessing a knowledge of the food habits of wild birds will for a moment contend that any species will ever exterminate any species of injurious insect, it is equally clear that if present in sufficient numbers our insectivorous birds do materially help to maintain the balance of Nature, and so prevent certain species of insects from becoming so numerous as to assume the dimensions of a plague. There is now ample evidence to prove this, both in our own country and elsewhere.

Unfortunately, in this country, the species of wild birds that are truly insectivorous in their habits are not plentiful. During the past few years two causes have materially tended to bring about a great reduction in their numbers, viz. the severity of the winters of 1916–17 and 1917–18, particularly the former, and the misguided enthusiasm of certain individuals who, in and out of season, claim protection for practically every species of wild bird. This latter cause, in our opinion, has been as fully disastrous as the severity of our climate. When a certain section of the educated public shuts its eyes to the enormous depredations that a comparatively few injurious species of wild birds commit, and is so prejudiced as to misrepresent facts, one result is inevitable, viz. those who are the sufferers and losers wrongly take matters into their own hands and proclaim a ruthless war on all species of wild birds. This is what has taken and is taking place in the country at the present time, much to the detriment of the agriculturist, fruit-grower, etc. Moreover, this is likely to continue so long as the biased view of uniform protection is advocated, with the result that year by year we shall see great plagues of caterpillars making their appearance and devastating the countryside. Crops will be lost, the supply of our home-grown food materially lessened, and the numbers of our insect-eating wild birds must continue to grow less.

The outlook is not a cheerful one, and it is fraught with exceedingly grave possibilities, much graver and more far-reaching than most people realise.

With the first cause we are, at present, unable to deal, although it is exercising the minds of many as to the best manner in which to counteract or checkmate this misguided and pernicious zeal. For the second, however, we believe there is a remedy, if not wholly, at least in part, viz. the enlightenment of the agricultural community as to the part these birds play in the economy of Nature; and this is the immediate object we have in view. For we believe that if, without bias or prejudice, the facts are truthfully and carefully laid before those interested, this terrible destruction will be arrested to an appreciable extent.

The thoughtful reader will no doubt inquire, "Do not the Wild Birds' Protection Acts afford complete protection to these species of birds and an effective means of preservation?" Our answer is "No." To a very large extent the Act of 1880 and its four supplementary Acts are practically dead letters. From 1880 to the present time they have all proved largely ineffective.

The actual number of species of insectivorous wild birds we have in this country is comparatively small, and many visit us for only a brief season of the year. Of the few that remain throughout the year a heavy toll has been taken. Let us consider briefly the nature of the food and the feeding habits of some of these.

The fieldfare, water ouzel, wheatear, whinchat, stonechat, redstart, and robin are all above suspicion. The warblers and wrens (excepting the whitethroat and blackcap) belong to a like category, as also the hedge accentor, dipper, tits, wagtails, pipits, flycatchers, swallow, martins, and tree creeper. Of the finches we must except the greenfinch, chaffinch, house sparrow, and bullfinch, the two latter being wholly injurious. So far as their food habits are known, none of the buntings are injurious. In some districts the corn bunting is rather plentiful and has been accused of damaging grain and ricks, but much more careful investigation is necessary before condemning it. All the larks do far more good than harm, whilst the swift, nightjar, woodpeckers, wryneck, kingfisher, cuckoo, and owls are all most beneficial. Thus, of the 280 species of British birds, excepting those aquatic or littoral in their habits and the game birds, we have somewhat fewer than a hundred insectivorous species, many of which are quite rare. Surely it is to the interest of the agriculturist and fruit-grower to do all in their power to help to protect and increase these beneficial species, which constitute a really important factor in crop production.

Some during the whole of the year, and others during the period they are in this country, are feeding almost entirely upon insects and the seeds of weeds. It is difficult to estimate the enormous bulk of food that they consume, but we can form some idea when it is stated that a bird about the size of a skylark consumes about 6 lb. of food per year, so that 10,000 birds would require about 27 tons of food in a year, of which fully half or more consists of insects and caterpillars.

Taking a miscellaneous lot of insects and caterpillars from the stomachs of ten skylarks, we find that in the different individuals, according to the particular species of insects eaten, 174, 160, 162, 162, 177, 182, 156, 138, 154, and 156 weigh exactly one ounce, or an average of 162, so that 10,000 birds would consume 78,382,080 insects in a year, whilst every 1000 birds would account for nearly 8,000,000, and each bird an average of 8000 per year. In all probability our smaller species of insect-eating birds consume a number of insects far in excess of these figures.

Bird counts, such as have been carried out in the United States of America, do not exist in this country, so we cannot state even approximately the number of insect-eating birds we have in the United Kingdom, but assuming that there are 32,000,000 acres of land under cultivation and that we have a pair of birds to every four acres, these 16,000,000 would consume annually 135,411,328,000 insects. Such figures require some thinking about before we can realise or form any true conception of the vast quantities that are included in such measures. It is impossible fully to realise the millions of insects and caterpillars that birds destroy just at the season of the greatest agricultural activity.

Wherever insectivorous birds have been destroyed there has followed an increase or plague of injurious insects. Scores of cases are on record, such as the destruction of woodpeckers and tits in the forests of Saxony and Brandenburg prior to the year 1798, in France in 1859–60, in Nebraska between 1865–77, and in Russian Siberia in 1893–94.

An anonymous writer stated a short time ago: "Some of the very greatest friends that our nation has are being destroyed without mercy. If the British Navy were threatened with destruction, a great cry would rise from the people, but only whispers are heard now and then about the slow destruction of a defensive force upon which most of our prosperity depends."

Surely we shall not appeal in vain to the various agricultural and horticultural organisations of this country to bring the weight of their influence to bear on a matter so vital to the country's interests. If the cultivation of the land has to prove profitable, it can do so only by preserving and utilising every factor that is favourable to crop production, and so long as economic entomology and ornithology remain neglected or only of academic interest in the United Kingdom, it behoves us to awaken and to take heed where we stand, or for some years to come our land will groan with the cry of desolation, due to our apathy and the ignorance and neglect of the ways and habits of our insectivorous birds, and the wanton destruction of what has ever been Nature's means of adjusting the complications of animal life, which man in his ignorance is seeking to pervert.

WALTER E. COLLINGE.

INDIAN INDUSTRIAL PROGRESS.

TWO publications[1] have recently been received which would indicate that decided progress is now being made in industry in India, owing to the stress involved under war conditions. The Indian Munitions Board undertook its formal duties as a Department of the Government of India in April, 1917, its primary function being the utilisation to the utmost extent of Indian resources in materials of all kinds required for the prosecution of the war.

When considered from a broad aspect, the munitions for a modern army cover practically all the wants of a civil community, with the addition of the special weapons, the armies' munitions, etc., which are employed by the soldier or sailor in actual fighting operations. With the enormous armies which are now used in warfare, the scale of operations is such that the wants of these fighting men necessarily compete with the requirements of civil life; hence the necessity for departments which will be able to cover the whole aspect of the economic and other life of a country. India has hitherto been mainly an agricultural country, but with the operations of war preventing supplies reaching India from England and other countries, it has become essential that many manufactured articles, which were formerly solely imported into India, must now, or, at all events, so long as the war lasts, be largely manufactured in India itself.

It is probably not too much to say that, owing to the influence of the war, India has already made progress which would otherwise have occupied almost a generation, and the Report on the Indian Munitions Board now available shows that its activities have been manifold.

The Indian Munitions Board was fortunate in being able to secure as its President Sir Thomas Holland, who was formerly for some years Director of the Geological Survey of India, and happened to be in India as head of an Industrial Commission which was engaged in developing India's industrial resources. The Board consists of the President, Sir Thomas Holland, assisted and advised by four members; and it is attached to the headquarters of the Government of India. At headquarters the work is divided into a number of well-defined branches, each branch being under the administration of a Controller. There are also provincial organisations in the different parts of India, and nine Controllers of the principal provinces, provided with proper deputies and assistants, have been appointed.

The provincial Controllers are responsible for utilising local industries which are not within the sphere of the special branches at headquarters. The organisation, therefore, appears to be fairly complete. The subjects dealt with under the control and supervision of Government are very varied, but the main object of these changes appears to be the utilisation of all indigenous materials and their exploitation so far as possible. As indicating the diverse activities now being carried on by the Indian Munitions Board, it may be mentioned that such special subjects as the following are now being worked at:—Timber supplies and resources, hides, tanning, and leather, the chemical and metallurgical industries of India, the potash salts in India suitable for chemical manufactures, manufacture of organic chemicals, essential oils, and perfumes, glycerine manufacture, wood distillation, indigenous dyes, etc. It would hence appear that great developments may be expected in future in the industries of India.

In connection also with the Indian Munitions Board, a conference was called by it for the consideration of the reorganisation of chemical research in India, the meeting being held at Lahore on January 8 last. This was attended by the majority of qualified and skilled chemists in

[1] "Indian Munitions Board Handbook" and "Proceedings of a Conference for the Consideration of the Organisation of Chemical Research in India, held at Lahore, January 8, 1918." (Simla: Government Monotype Press.)

India, and appears to have been a great success. At the present time, what is under consideration is the form of reorganisation which would be best; but it would appear that it is possible that economic research departments may be recognised under a director-general of chemistry with deputy directors for various special branches of economic science, and that all chemists in Government employ should be included in the service, the reorganisation being intended, of course, to increase the output of work and to prevent overlapping. Thus, if there were a director-general of chemistry in India, the deputy directors working under him would include a deputy director for agriculture and a deputy director for forest products, while the provincial agricultural and forest men of science would work in co-ordination with their brethren in other provinces under instruction from, and in general consultation with, their particular deputy director. Apparently, there would also have to be separate directors, say, for organic chemistry and also in charge of mineral chemistry, etc. If this were carried out properly India might make extremely rapid progress in industry and commerce, and in such a way that its future may be revolutionised.

NOTES.

FROM a White Paper published on July 10 we learn that among the Supplementary Estimates for the year ending March 31, 1919, is the sum of 1,000,000*l.* which is to be devoted through the Board of Trade to the purpose of assisting the dye-making industry. This is the first instalment of a total sum of 2,000,000*l.* to be provided in the shape of loans and grants to be spread over three years, and divided as follows:—1,250,000*l.* in loans at not less than 1 per cent. above the Bank rate, with a minimum of 5 per cent., repayable in twenty years or earlier if the profits of the manufacturer are more than 9 per cent.; 600,000*l.* in aid of extensions of plant and buildings; and 150,000*l.* in grants in aid of research. It will be remembered that early in 1915 a grant of 1,000,000*l.* was made to one firm at Huddersfield, out of which was created the company known as British Dyes, Ltd. This, not unnaturally, created a feeling of dissatisfaction on the part of those dye-making firms which received nothing. The sum mentioned is to be distributed among these firms, besides the substantial amount allocated to the purposes of research. Presumably the 100,000*l.* given for this purpose in 1915 has been spent, but it would be interesting to know how and by whom the money has been used and with what results, in view of the fact that the central research laboratory originally contemplated has never been erected, nor the Technical Committee announced in July, 1915, called into existence.

WE publish this week an article dealing with recent advances in scientific plant-breeding, in which the remarkable progress made in recent years, especially in India, is described. As a pendant to this article we may invite attention to the announcement made in Parliament by the President of the Board of Agriculture on July 18 that active steps have been taken with a view to the establishment at Cambridge of an Institute of Agricultural Botany, the primary function of which will be the breeding and distributing of improved varieties of agricultural crops. The scheme in question was very fully described by Mr. Lawrence Weaver, of the Board of Agriculture, at a meeting of the Agricultural Seed Association held on July 15. It appears that the new institute will be modelled on the famous Swedish plant-breeding station at Svälof, and that its activities will be to follow two distinct lines, one of which will be purely scientific, while the other will have a commercial outlook. More precisely, the scientific wing will be concerned with the producing of pure cultures of new varieties on the field-plot scale; the economic wing will deal with the growing and distribution on a large scale of these varieties. Presumably, on the Svälof model, the scientific side will oversee the operations of the commercial to the extent of guaranteeing the purity of the stocks distributed by the latter. It has been announced that subscriptions towards the establishment of the new institute amounting in the aggregate to upwards of 30,000*l.*, have already been received, including a sum of 10,000*l.* down and 2000*l.* a year for five years from the firm of Sir Robert McAlpine and Sons. It has also been announced that the Board of Agriculture will provide the necessary buildings and equipment. It is most gratifying to have this evidence of the growing appreciation by the public of the value of scientific work in economic directions. The new institute may be confidently expected to have a profound influence on the future development of British agriculture.

THE question of the payment for the services of scientific men working in connection with the industrial research associations being formed on the lines suggested by the Department of Scientific and Industrial Research has been raised in the House of Commons by Sir William Beale. Though the associations could make remuneration to scientific men appointed to serve on advisory committees, or to specific posts constituted by them, they were not authorised to pay them for services as members of councils or boards of management. It has now been decided by the Board of Trade that this condition may be abrogated, and payment can be made after approval by the Department of Scientific and Industrial Research. Sir William Beale's question, asked on July 18, and Sir Albert Stanley's answer, are as follows:—*Sir William Beale:* To ask the President of the Board of Trade whether he is aware of the conditions under which scientific men are asked to serve on the councils or boards of management of industrial research associations formed under the direction or with the approval of the Board to carry out or promote scientific and industrial research, in consequence of the rules and practice prescribed by the Board of Trade to discourage payment for such services rendered by scientific men other than reimbursement for out-of-pocket expenses; and whether the Board has taken or will take steps to enable such further reasonable remuneration to be paid as will attract to or at least make possible for such research committees as are being formed in connection with the Department of Scientific and Industrial Research the co-operation, advice, and assistance of scientific men of undoubted capacity to render valuable services whose position and means do not enable them to do so on mere compensation for out-of-pocket expenses. *Sir Albert Stanley:* In dealing with applications for licences under the provisions of section 20 of the Companies Consolidation Act, 1908, due provision is made for the payment of reasonable remuneration to members of the council of management of such industrial research associations with the approval of the Department of Scientific and Industrial Research.

THERE is a strongly expressed opinion among those engaged in the fisheries industries that the time has now come for the establishment of a separate Ministry or Board of Fisheries. The National Sea Fisheries' Protection Association carried a motion, at its annual meeting at Fishmongers' Hall last week, pressing for such reconstruction and appointing a deputation to wait upon the President of the Board of Agriculture and Fisheries. In other quarters the same attitude is now being generally taken up. The needs of the immediate future—that is, unification of control, better local administration, scientific research in relation to fish as food, the better training and education of boys passing into the deep-sea fishing industry, and increased facility of distribution—do not seem likely to be satisfactorily dealt with under the present system of local and imperfect central control. The question of reconstruction of the present depleted fishing marine is also regarded as one of great importance, and it is felt that postponement of this until after the war may be prejudicial to the future of the industry, and that it can be adequately considered only by a strongly organised Department of Fisheries.

THE establishment of a Ministry of Health has attracted considerable public attention, and a widely signed national memorial in support of this has been forwarded to the Prime Minister by Sir Kingsley Wood. In the House of Lords on July 17 Lord Willoughby de Broke directed attention to the desirability of establishing a Ministry of Health without undue delay, and moved a resolution to that effect, which was carried. He pointed out that we are faced with the lowest birth-rate on record, and that the Registrar-General had estimated that but for the war there probably would have been 650,000 more babies born in England and Wales since 1914 than there had been. The motion was supported by Viscount Haldane, who said that far the greatest loss of population was ante-natal rather than post-natal, and urged that the matter required careful scientific investigation. There ought to be an authority like the Board of Education working through borough and county councils, the effect of which would be that the Local Government Board would become what it primarily ought to be—a ministry of public health, and only secondarily a ministry of local government. Viscount Peel, who replied sympathetically on behalf of the Government, said that there was no suggestion that the Maternity Bill was to be substituted for a measure co-ordinating all the powers of the central authorities. There were considerable difficulties to be overcome, and the matter could not be dealt with in a Bill of a few clauses. To attempt to separate the administration of local government from health questions would be deplorable, and there would be great difficulty in separating the health functions of the administration of the Poor Law from functions connected with public assistance.

THE death is announced, on July 18, of Dr. F. Hodson, for several years science master at Bedales School, Petersfield, and the author of "Broad Lines in Science Teaching."

WE regret to note that the death of Mr. John Frederick Robinson is announced in *Engineering* for July 19. Mr. Robinson was born in May, 1853, and was a director of the North British Locomotive Co., Ltd. He was educated at Owens College, Manchester, and served an apprenticeship with Messrs. Sharp, Stewart, and Co., Ltd. He was a member of the Institution of Civil Engineers, and served on the council of the Institution of Mechanical Engineers during the period 1902–9.

DR. W. J. M. ETTLES, whose death on July 19, at fifty years of age, as the result of an operation, we record with much regret, was distinguished not only by his work as a consulting oculist and ophthalmic surgeon, but also by his knowledge of the principles of physical optics, as evidenced by the fact that he had been president of the Optical Society, as well as of the Hunterian Society. Dr. Ettles qualified as M.B., C.M., at Aberdeen in 1890, and after a few years' practice in London he returned and graduated with highest honours as M.D. in 1896. He gave the Hunterian oration in 1908 upon the subject of "The Renaissance of Ophthalmology during the Hunterian Era," and he contributed to the Transactions of the Optical Convention in 1905 a paper on "Optical Principles of the Ophthalmometer, with Descriptions of New Instruments." Dr. Ettles was particularly interested in colour-vision tests, and played an important part in the "Trattles" case of about ten years ago, which led to a revision of the methods adopted by the Board of Trade in examining in colour-vision candidates for certificates as master or mate in the mercantile marine. His death while in the prime of life will be deplored by many friends, as well as by numerous patients who have had the advantage of his professional knowledge and skill.

ATTENTION having been directed in Kentish papers to the desirability of establishing the new marine grass, *Spartina townsendii*, in the extensive mud-banks of the Medway between Chatham and Sheerness, the owner of some "saltings" has decided to act on the suggestion, and, having through Mr. W. H. Shrubsole secured the co-operation of South Coast naturalists, arrangements are now in progress for collecting and transferring plants to the Medway. On the Essex coast there are large marshy areas suitable for the growth of Spartina; and if it were planted there and in similar districts around our shores it is highly probable that before many years our supply of home-grown material for paper-making would be considerably increased.

AT the invitation of the council of the Institution of Electrical Engineers, a conference of representatives of the Associated Municipal Electrical Engineers of Greater London, the Chief Technical Assistants' Association, and the Electrical Power Engineers' Association was held at the temporary offices of the institution on July 9. The chair was taken by Mr. C. H. Wordingham, C.B.E., president of the institution. At the close of the proceedings it was resolved that one single combined protective association be formed for the whole electric supply industry. Chief engineers will be included in the membership provided they are not employers or employers' representatives on an industrial council or similar body dealing with technical staffs. The qualifications for membership of the association will be those of the Electrical Power Engineers' Association, but all new members elected after December 31, 1921, shall be required to have passed the A.M.I.E.E. examination or an equivalent examination.

DR. R. R. MARETT, who has held the office of president of the Folklore Society for the unusually long period of five years, devoted his final presidential address to a discussion of the transvaluation of culture. He protested against the description of the science of folklore as the study of survivals. It would be better, he believes, to reject the fossil metaphor altogether. Inasmuch as survivals survive, they are not quite dead after all, but in some humble and surreptitious way of their own help to constitute and condition the living present, whether it be for worse or better. It is of chief importance to inquire what survival is as a process, and how this particular process is related to the other processes that go with it to make up the general movement of history. In short, a dynamic study of the facts relating to survival keeps in touch with reality as manifested in the life-force.

IN the *South African Journal of Science* (vol. xiv., No. 4) for November, 1917, Prof. J. W. Bews discusses the plant-succession in the thorn veld. The acacias, especially *Acacia horrida* and *A. arabica*, are the pioneers, as they are able to establish themselves with no shade, shelter, or protection against grass-fires. After they are established many other species, germinating in the seed-bed prepared for them by the activity of earthworms, termites, and ants beneath the thorn-tree, grow up in the shade. Various stages have been traced, and ultimately the subsequent species may kill the pioneer. As a rule, however, the thorn-trees remain dominant in what is, at present, over the largest areas, the final stage. Seed-dispersal is little due to wind, the chief agents being birds, but for species with capsular fruits and small seeds, ants, which are very abundant, play an important part. Termites also exert important influence on the plant-succession.

THE various forms of "scab" found on potato-tubers have for long been more or less puzzling to plant pathologists. The investigations of recent years have considerably enlarged our knowledge of parasitic organisms such as *Synchytrium endobioticum*, *Spongospora subterranea*, *Actinomyces chromogenus*, etc., and of their effects upon the tuber. Workers in this domain of research will be interested, therefore, in a paper published in the *Journal of Agricultural Research* for May 27 by Mr. J. J. Taubenhaus, who describes a form of scab of the sweet potato which he calls "Pox," and which also occurs on the ordinary potato (*Solanum tuberosum*). According to this author, the causative parasite in this case is a myxomycete named *Cystospora batata*, Ell., which probably hibernates as cysts in the soil. It would be interesting to know whether this organism occurs in the Old World as well as in the New, and doubtless the publication of the paper referred to will stimulate search for it.

THE damage to tomatoes and other valuable glass-house crops due to the root-nematode or eelworm (*Heterodera radicicola*) is widespread and considerable, and, so far, no economical and effective measures of control have been devised. Some experimental work on this subject is described in an article by Mr. Willis P. Durz in *Soil Science* (vol. iv., No. 6), in which the application of sodium cyanide to infested greenhouse soil was tested, and under certain conditions gave satisfactory results. The cyanide dissolved in water was applied in the proportion of 200 lb. per acre, one-third gallon per square foot of soil, as weaker solutions were found to be ineffectual; one week after the first treatment a second similar treatment was given. In order to bring out the larvæ from their cysts the soil was kept moist and warm for about five days before each application. All plants should be removed from the soil before applications of sodium cyanide at this rate, and the soil should be aerated and leached to remove any traces of cyanide gas before replanting. Other methods of control recommended are the application to the soil of formaldehyde and of sphagnum-moss extract and the raising of the temperature of greenhouses to 101° F.

THE latest addition to Messrs. E. Stanford's series of war-maps is a map of Denmark, Schleswig-Holstein, etc., published at the price of half a crown. The scale is approximately 1 : 1,140,000. No relief is shown, but water under ten fathoms is coloured lighter blue than water of greater depth. International boundaries on land are shown in red. It would have been useful to mark the boundary of the Danish Archipelago towards Sweden and Germany by a dotted line. The map has plenty of names, and railways are clearly marked. The courses of the British and German fleets at the Battle of Jutland are shown in red.

WE have received from the Commonwealth Meteorologist a copy of the rain-map of Australia for 1917. Besides the chief map showing the details of the annual rainfall, the sheet has smaller maps giving the rainfall for each month during the year. The small maps are clear, but the principal one is very obscure in places. Previous editions had not this defect, and it is to be hoped that it represents merely a passing phase of difficulty in printing. The abnormal conditions of rainfall were even more pronounced in 1917 than in 1916, and 75 per cent. of the area of the country had a rainfall above the average. Some parts of Western Australia had the wettest year on record. Throughout the wheat belt rains in general were much above the normal, especially during August, September, and October. In parts of Victoria, New South Wales, and Western Australia too much rain injured the wheat harvest, the returns of which were considerably below the average. The unusual conditions are attributed by Mr. H. A. Hunt partly to the strong monsoonal influences in summer and partly to the exceptional development of southern low pressure in winter. Very similar conditions prevailed in 1916.

IN the Journal of the Royal Society of Arts (No. 3417, May 17) Mr. Alfred Dickinson discusses "Water-power in India." As an example he quotes the dam across a valley in the Western Ghats constructed by Messrs. Tata, Sons, and Co., which provides 300,000 h.p. continuously. Mr. Dickinson is now investigating the possibility of utilising the irrigation lake at Perigar, in the Madras Presidency, for power purposes, and numerous other schemes of the same kind are possible. With its enormous supply of minerals for metallurgical development, materials like cotton, flax, and jute, and abundant and cheap labour, a great commercial and industrial development may be expected. "Although much has been done, her industrial possibilities, to use a vulgarism, have scarcely been 'scratched.'"

THE Engineering Experiment Station of the University of Illinois has published Circular No. 6, March, 1918, by Prof. H. H. Stock, upon the storage of bituminous coal. This subject has attracted considerable attention within the last few months on both sides of the Atlantic, papers having appeared on the subject in the publications of the Canadian Department of Mines and in the Transactions of two English engineering societies, whilst the theory of the spontaneous combustion of coal, which forms, or should form, the basis upon which all methods of coal storage are based, has been worked out at the Doncaster Coalowners' Laboratory. The present circular practically disregards the theoretical side of the subject, but concerns itself more particularly with the engineering features of coal storage. The various methods of storing coal are described in much detail, and, amongst others, the method of storing under water is fully considered. The various precautions in the way of thorough ventilation of the pile, restricting its height and subdividing it suitably, as well as the proper grading of coal intended to be stored, are all discussed, and stress is laid upon the importance of regular inspection and determination of the temperature of the pile; the author holds that when the temperature reaches 150° F. the pile needs to be carefully watched, and if it rises to 175° or 180° F. the coal should be removed as promptly as possible.

To which country is the advance of seismology chiefly indebted? M. de Montessus de Ballore endeavours to answer this question in an interesting paper published in the last *Bollettino* of the Italian Seismological Society (vol. xx., 1916, pp. 263-72). His estimate is based on a bibliography of seismological memoirs now being published by the Sociedad chilena de historia y geografia. This bibliography contains the titles of about 9000 articles, of which 2002 are written in Italian, 1768 in French, and 1185 in German. Great Britain is credited with 911 articles, the United States with 636, and Japan with 352. The number of papers per million inhabitants since the year 1840 is 40 in Italy, 30½ in France, 12½ in Germany and Austria, and 10½ in Great Britain. These figures take no account of the value of the individual works. Omitting purely descriptive papers, the author estimates that of papers of a general nature 12·9 per cent. are contributed by French writers, 10·6 per cent. by German, 10·2 per cent. by English, and 7·7 per cent. by Italian writers. A more satisfactory conception of the relative value of national contributions would perhaps be furnished by the number of references in some standard treatise on seismology. Taking, for instance, M. de Montessus de Ballore's "La Science Séismologique," and including only those authors quoted more than five times, we find that there are 103 references to English writers, 65 to Italian, 61 to German and Austrian, 49 to Japanese, 35 to French, and 21 to American (United States).

A NOTICE in *Metall und Erz* for May 8 states that the important Bavarian establishments for the production of nitric acid from the air are to undergo considerable extension, in which some 200,000 h.p. of water-power will be used. A strong syndicate of bankers and others has been formed to carry out the scheme, which will involve a capital of 150 million marks.

FOLLOWING upon the establishment of the Kaiser Wilhelm Institute for Research on Iron and Iron-ores comes the news from the German daily Press of some preliminary steps that have been taken to found a similar institution for researches on all other generally useful metals. A committee composed of eminent engineers and university professors has been formed to consider the establishment of a metal research institute for the benefit of the German metallurgical industry.

NEW sources of mineral wealth are to be found in European Turkey. According to *Metall und Erz* for May 8 last, copper-ore exists in great quantities in Turkish Rhodope, in the neighbourhood of Yardimli. In the Turkish Balkans ores of nearly all the metals occur, while gold occurs in Markova Reka, south of Uskub. In the neighbourhood of Kratova gold and galena containing a fairly high percentage of gold have been discovered. Chromium-ore in abundance has been found near Niausta, on the Salonika-Monastir railway. The mountain range of southern Macedonia is especially rich in chromium-ore, and there are iron, antimony, and lead ores.

IN the *Schweizerische Elektrotechnische Zeitschrift* for January 5 last is given a summary of the results obtained from tests of various lamps with orthochromatic plates and silver-eosin plates prepared by two German firms. The tables show wattage and candle-power of various lamps and their actinic values, absolute and per watt and per Hefner candle-power for both kinds of plates with and without yellow filters. The lamps tested in this way were the Hefner lamp, vacuum and gas-filled tungsten-wire lamps, arc lamps with solid carbons and yellow and white flame-carbons, enclosed arcs, and quartz-enclosed mercury arcs.

WE note in the *Chemical News* of June 21 an account of the preparation and properties of fibres made from fused steatite or soapstone (a magnesium silicate), which resemble fused quartz in their elastic properties. It was desired to obtain threads of 0·1 to 0·2 mm. in diameter and a metre long; such threads are somewhat difficult to prepare from fused quartz on account of the presence of air-bubbles. The material in question was found by Prof. Guthe (Bureau of Standards, Washington, Bulletin i., No. 1) to answer admirably; it had all the characteristic properties of fused quartz with the additional advantage that thick fibres do not break so readily. In the oxyhydrogen flame the substance fuses to a clear glass, and can be formed into threads of the requisite dimensions. The elastic fatigue of such fibres is very small—about one-third that of steel or phosphor-bronze. The linear coefficient of expansion was found to be −0·0000045.

AN article on coal-saving by the scientific control of steam-boiler plants appears in *Engineering* for July 12. The author, Mr. D. Brownlie, gives average figures for 250 typical steam-boiler plants, covering the period from 1910 to the present time. It is estimated that 58,500,000 tons of coal per annum are used in this country for steam-raising purposes (in normal times), exclusive of 15,000,000 tons used in railways. The 250 plants had a total of 1000 boilers, principally of the Lancashire type. With hand-firing the average net working efficiency is 57·8 per cent., as against mechanical firing with an average net working efficiency of 61·4 per cent. Both varieties receive very little scientific attention and supervision; efficiencies from 75 to 82½ per cent. can be maintained with both types. The author's experience is that in normal times the average firm could save 7 to 10 per cent. in the fuel bill alone by buying on scientific lines. The author estimates that there are 45,000 to 60,000 steam boilers at work in Great Britain, calculated in terms of average-sized Lancashire boilers, and considers that all the steam produced in the country to-day could be obtained much more economically with 25 per cent. fewer boilers.

MESSRS. *Crosby Lockwood and Son* announce "Plane Surveying," by Prof. J. K. Finch, and "How to Become a Wireless Operator: A Practical Presentation of the Theory of Electrical Waves, their Propagation, and their Adaptation to Wireless Communication," by C. B. Hayward. Messrs. *Longmans and Co.* have in preparation a new edition—the second—of Sir R. A. S. Redmayne's "The Ventilation of Mines," containing additional notes relating to the Coal Mines Act of 1911. The fifth volume of the same author's "Modern Practice in Mining" is also in preparation. *Sir Isaac Pitman and Sons, Ltd.*, will issue shortly "A Small Book on Electric Motors for Continuous and Alternating Currents," by the late W. Perren Maycock.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, W.C.2, have just issued, at the price of 2d., a very full and well-arranged Botanical Catalogue (new series, No. 83), which should be of interest and value to many of our readers. It is conveniently divided into eight sections, dealing respectively with general botany, geographical botany, and the floras of Britain, Europe, Asia, Africa, America, and Australasia. Many first and rare editions are included;

also sets of botanical serials. Among the latter we notice Curtis's *Botanical Magazine* from 1787 to 1906; Edwards's *Botanical Register*, a complete set; Maund's "Botanic Garden," large-paper edition; the Transactions of the Linnean Society of London, complete to 1916; the *Orchid Album*; the *Orchid Review*; the *Phytologist*, by Luxford, Newman, and Irvine, all published. Messrs. Wheldon also have for disposal a large-paper copy of Loddige's "Botanical Cabinet," complete in 20 vols.

OUR ASTRONOMICAL COLUMN.

PERIODIC COMETS.—Wolf's comet was detected by Prof. Barnard at Yerkes Observatory on July 12, three days later than M. Jonckheere's first observation. M. Kamensky's predicted date of perihelion, 1918 December 13·3899, appears to be too early by 0·0531d., which is not a large error, and the ephemeris given in NATURE for July 11 will suffice for finding the comet.

Borrelly's periodic comet will pass perihelion a month earlier than Wolf's, and the conditions will be favourable for observation. Mr. L. v. Tolnay gives the following ephemeris in *Ast. Nach.*, No. 4948; it is for Greenwich midnight:—

	R.A. h. m. s.	S. Decl. ° ′	Log r	Log Δ
July 29	3 19 0	17 1	0·2653	0·2107
Aug. 2	3 28 5	16 41	0·2591	0·1972
6	3 37 10	16 21	0·2529	0·1835
10	3 46 15	16 1	0·2467	0·1696
14	3 55 18	15 41	0·2405	0·1554
18	4 4 19	15 20	0·2343	0·1411
22	4 13 17	14 59	0·2282	0·1265
26	4 22 12	14 37	0·2222	0·1116
30	4 31 4	14 13	0·2162	0·0964

The perihelion passage is about November 16·65, log a=0·5598, e=0·6153, log q=0·1450.

THE PERIOD OF SIRIUS.—The companion to Sirius has lately been more easily observable than during the previous forty years, and has completed rather more than a revolution since its discovery in 1862. Mr. R. Jonckheere has obtained measures with the 28-in. refractor at Greenwich in the course of the last four winters, and has taken the opportunity of making a revised estimate of the period (Monthly Notices, R.A.S., vol. lxxviii., p. 480). The mean result is 50·02 years, which is 1·78 years shorter than that given by Burnham. The shortest period ever given was that of 48·84 years, arrived at by Zwiers, and the longest that of 58·47 years given by Gore. Mr. Jonckheere recalls that nearly eleven years before the visual discovery Peters made an investigation of the orbit from transit observations, and although the maximum displacement was only 0·152s., he obtained the closely accurate period of 50·01 years. Adopting the parallax 0·38″ and a semi-major axis of 7·5″, the corrected mass of the system is 3·07 times the mass of the sun.

TWO SPECTROSCOPIC BINARIES OF LONG PERIOD.—The spectroscopic binary 32 θ_2 Cygni has been under observation at the Dominion Observatory, Ottawa, by Mr. J. B. Cannon since 1914, and a preliminary orbit has now been determined (*Astrophys. Journ.*, vol. xlvii., p. 193). The period of this star is more than three years, and the eccentricity of the orbit 0·182, but there are irregularities which suggest the presence of a third body. The velocity-curve may be explained by considering the system as consisting of a luminous star revolving about another body in a circular orbit in 390 days, and the pair revolving in an elliptic orbit about a third body in 1170 days. The star is of spectral type G5 and magnitude 5·15.

A spectroscopic binary of still longer period has been under investigation at the Cape Observatory by Dr. J. Lunt since 1903. The star in question is α Phœnicis, and the period has been found to be 10·62 years, or 3880 days. The eccentricity of the orbit is 0·32, and the system is receding with a velocity of 75·76 km. As regards length of period, the star is second only to Polaris, which has a period of 11·9 years. The star is of magnitude 2·44 and of type K.

STONYHURST COLLEGE OBSERVATORY.—The annual report of this observatory for 1917 includes a valuable record of the state of the sun's surface on 210 days of observation. In units of one five-thousandth of the visible surface the mean disc-area of the spots was 12·1, which is about three times greater than that of the previous year, and twice as great as at the previous maximum. The increased activity commenced early in February and reached its greatest intensity in August, the greatest area on any one day being 50 units on August 11. The February and August groups were of exceptional size, and second to none that have appeared during the last thirty-eight years. As regards the ranges of magnetic declination and horizontal force, the year was relatively quiet and out of accord with the solar activity. A comparison of the Stonyhurst drawings with spectroheliograms taken at the Yerkes Observatory has shown an almost perfect agreement between the faculæ and the calcium flocculi, but no similarity with the hydrogen flocculi. The report also includes particulars of meteorological and magnetical observations.

THE FUTURE OF THE ELECTRICAL TRADES.

THE Departmental Committee appointed by the Board of Trade to consider the position of the electrical trades after the war, with special reference to international competition, has now issued a Report (Cd. 9072, price 2*d*.). Like other similar Committees, this urges that "remedial and unifying legislation governing the supply and distribution of electrical energy should be introduced forthwith." A historical *résumé* of electrical enterprise in this country is given, and it is pointed out that, like the automobile industry, it has been hampered all through by the lack of a scientific outlook on the part of the officials of our Government Departments. Acting according to their lights, they encouraged competing companies using different types of plant and different systems to set up in the same area, the reason given being that the healthy competition would cheapen the supply to the consumer. The mischievous effect of this policy is well illustrated by the circular issued by the Board of Trade in 1916 calling on the supply companies to link up with one another in the national interests so as to reduce the consumption of coal and economise labour. That is, after making it practically impossible for the companies to link up, the Board calls on them to do so.

Looking to the future, the Committee points out that as the supply of electrical energy is a "key industry," it is imperative that questions concerning it should be prevented from becoming party questions. They should be considered solely on their merits from the point of view of national requirements. We quite agree, but we are afraid that this is a counsel of perfection. Few questions are of greater urgency than that of standardising some system for electrifying all our railways. The power stations need to be placed in the best positions for civil and military needs, and all main and local lines should be properly co-ordinated. At present our railways are being electrified in a piecemeal and desultory way. A comparison is made between manufacturing conditions in this country and in Germany. The conclusions, with some of which we do not agree, are altogether in favour of the German methods. The Committee was impressed by the fact that the balance-sheets of the Allgemeine Elektricitäts Gesellschaft showed a cash balance of more than six million pounds in 1915. Another flourishing firm, the Siemens-Schückert Co., has stated that its large cash balance will shortly be depleted by the manufacture of "peace products" for stock for disposal at the end of the war.

At least, up to the present time, German manufacturing firms have had little to pay in the way of extra taxation or excess profits duty, and so English firms are naturally getting anxious. The Committee recommends that the import of enemy goods should be prohibited for three years after the conclusion of peace. Other recommendations are the imposition of import duties (in other words, Protection), combination between manufacturers, the provision of extended banking facilities, and, most important of all, the promotion of a better understanding between employers and employed and the provision of better housing and working conditions. A supplementary report is promised which will deal, *inter alia*, with education, research, the decimal system, and the consular service. As Sir Charles Parsons and Sir John Snell are on the Committee, their educational proposals will be looked forward to with keen interest.

ITALIAN METEOROLOGY.[1]

A NUMBER of interesting papers dealing with various aspects of meteorology in Italy, including results from a new station in the colony of Gebel Bengasi, have recently been issued by Prof. Eredia, director of the service. The first (1) contains the results of observations made at Nalut during the two years ending May, 1915. The co-ordinates of the station are lat. 31° 53′ N., long. 8° 45′ E., and the height 600 m. The mean temperature is 65·7° F.; that of the warmest month, July, 84·6°, and of January, the coldest month, 44·4°, showing the large variation of more than 40°. The mean daily maxima vary from 98° in July to 52·5° in January. The corresponding mean minima are 70·6° and 36°, so that the amplitude in the day values is 10° in excess of the night values. The mean daily range is 21·5°, and the absolute extremes of temperature are 111° and 23°. Compared with Tripoli, on the coast, the mean temperature is 1·6° lower. In summer (May to August) Nalut is 5° warmer than Tripoli, in winter 10° colder, the extreme differences being +6° in June and −11° in January. The annual rainfall is 194 mm. (7·63 in.), which almost all falls between December and April. The average number of days with rain in the year is nineteen. The rain falls in heavy showers of short duration, which, as a rule, do not exceed thirty minutes. Only on three occasions did the duration of a shower exceed five hours, although one rainstorm lasted two days. The heaviest fall was 1½ in. in two and a half hours, on April 4, 1915. December, 1914, was the wettest month, with 5·16 in., falling on four days during an aggregate of twelve hours, although in the same month of the previous year only 0·03 in. fell. There are 237 cloudless and 36 overcast days annually. The predominant wind is N. at all seasons, accounting for about half of all the observed winds, while winds from the E. and S.E. rarely occur.

The second paper (2) is a discussion of thunderstorm frequency over the north plains of Italy, with special reference to the barometric pressure at the time of the occurrence. Data from ten observatories are examined for the months April to October for the ten years ending 1916, with the general result that thunderstorms are most frequent with pressure under 755 mm. (29·73 in.), while a secondary maximum occurs between 759 mm. and 762 mm. Only in 5 per cent. of the cases was pressure more than 765 mm. The frequency is also discussed with reference to the relative humidity at the time of the thunderstorm. In summer the air was dry (under 60 per cent.) in one-third of the cases, but in early autumn only one thunderstorm in ten occurs with so dry an atmosphere.

The pressure conditions associated with two floods on the River Uadi, at Derna, on the coast of Bengasi, are discussed in (3), from which it is shown that in the flood of November 30, 1913, there was an anticyclone over Western, and a low-pressure area over Central, Europe. The wind at Derna, and, indeed, throughout Bengasi, changed from S. to N., indicating the passage of a depression to the north. In the flood of April 12, 1916, pressure was low to the north of Scotland and high in Portugal, with a subsidiary area of low pressure over Algeria. Details of some other rains associated with flooding in various parts of Tripoli and Bengasi are also given.

The last paper (4) summarises the work of the Italian Meteorological Office since its initiation in 1879. The geophysical branch dates from 1887, and upper-air research from 1902. In October, 1917, there were 181 stations provided with direct-reading and automatic registers, and other 341 stations observing rainfall, temperature, wind, and cloud. Of extra rainfall stations there were 161. Full particulars are given of the special researches carried out by the various sections.

A new edition of useful tables, such as are available in our own "Computers' Handbook," is given in (5), which include tables for the conversion of millimetres into the new pressure units.

R. C. M.

[1] (1) Prof. F. Eredia, "Contributo alla Climatologia del Gebel," *Biblioteca Agraria Coloniale.* (2) Prof. F. Eredia, "La Frequenza dei Temporali in Val Padana," *Rend. della R. Acad. dei Lincei.* (3) Prof. F. Eredia, "Le Piene dell' Uadi di Derna" (Ministero delle Colonie). (4) "L'Officio Centrale Italiano di Meteorologia e Geodinamica," Estratto da *La Scienza per Tutti*, No. 1, 1° Gennaio, 1918. (5) Prof. F. Eredia, "Tavole ad Uso degli Osservatorii Meteorologici Italiani."

GEOLOGY OF THE BARBERTON GOLD-MINING DISTRICT.

THE Geological Survey of the Union of South Africa has issued an important memoir on the geology of the Barberton gold-mining district. This district is made up essentially of the Older Granite and the Swaziland System, probably of pre-Cambrian age, and underlying the Transvaal System, the latter being of importance mainly as determining the great escarpment of the Drakensberg; it may be noted that the latter contains auriferous deposits, both reef and alluvial, that have been worked for some thirty-five years. The tectonics of the Barberton district are very complex, intense folding in various regions, such as the Sheba Hills, having been brought about by the intrusion of the great masses of granite. One of the most interesting features of this report lies in the conclusions reached respecting the genesis of the auriferous deposits of the Barberton district. Apart from the alluvials, auriferous deposits of two types are recognised, namely, pyritic quartz reefs and zones of impregnation. The former occur mainly in the granite of the De Kaap valley, and in some of the older rocks, and in many cases the results obtained from their exploitation have been, upon the whole, disappointing. The latter include some of the best-known deposits, such as the famous Sheba Mine; the deposits do not show definite walls, and the auriferous rock does not differ from the surrounding country except by its impregnation with iron pyrites and with gold, often very finely disseminated, so that the workable limits of the deposits can be established only by continual assays. It is pointed out that the zone of contact between the granite and the adjoining stratified rocks is the area within which most of the important gold-bearing deposits are situated, and it is suggested that "gold occurrences are far more likely to be expected within the sphere of influence of the intrusive granite," this forming a belt of country averaging about three miles in width. Furthermore, in prospecting, it should not be forgotten that many of the payable deposits of the Barberton district take the form, not of the well-defined quartz reef, with which most prospectors are familiar, but of "mineralised zones of impregnation, sometimes almost indistinguishable from country rock."

THE SPINNING-TOP IN HARNESS.[1]

THE gyroscopic theory of the lecture and its applications was illustrated by experiments with apparatus designed to show the chief principles of gyroscopic motion on a large scale, so as to be visible to an audience; some bicycle-wheels and a Maxwell dynamical top were used.

The lecture began with a quotation of the initial sentence of Maxwell's own description of his top, as given to the Royal Society of Edinburgh, April, 1857, and the phrase "the perplexities of men who had successfully threaded the mazes of the planetary motions" was interpreted as a sly, malicious dig at Newton and his struggle in the "Principia" with the gyroscopic theory of precession.

Twirled by the left hand, the dynamical top gives the appropriate precession in direction; called precession because the seasons come up in consequence of it twenty minutes earlier each year than otherwise, and twenty minutes a year gives the twenty-six thousand years required for a complete revolution among the stars.

Two large 52-in. bicycle-wheels were employed as spinning-tops on the floor, made originally by Prof. C. V. Boys for his Otto bicycle. A hub was fitted with ball-bearings, carrying a spike and a long stalk. Spun by hand, with the spike resting in a small cup raised about 3 ft. from the floor, the evolutions of the wheel could be watched as they became more violent, and finally extinguished when the rim reached the floor.

When the stalk was grasped and raised horizontal and the wheel spun, the gyroscopic effect was very marked if the wheel was allowed to drop or the stalk was brandished. Letting the spike rest in the hand, the wheel moved round in precession, and Kelvin's rule could be shown off in the alteration of the inclination of the axle.

According to this rule, "Hurry the precession, and the axle rises against gravity." This is observed instinctively in riding a bicycle on the road. To avoid an object the bicycle must be steered towards it in a smaller circle, so as to rise and swerve away. A bicycle cannot run straight.

The stability of the axle was shown by hammering the wheel-rim with a stick, causing it to flinch only slightly, but hurrying the precession.

The mathematical theory was too complicated to be undertaken in the course of an hour's lecture, even when stated in Poinsot's concise manner, "which has brought the subject under the power of a more searching analysis than the calculus, in which ideas take the place of symbols and intelligible propositions supersede equations."

The elliptic function theory arises in all its complexity, and appears as if created to speak the language of gyroscopic theory.

Two special cases of motion were suggested to interest the mathematicians in the audience, where the equations are quasi-algebraical, and may be employed as typical illustrations in the wilderness of general theory:—

(1) Project the axle of the gyroscope horizontally with no spin of the wheel; this gives a spherical pendulum motion, as of the bob of a simple pendulum projected so as to move in a spherical curve, and not in plane oscillation.

(2) Spin the wheel and hold the axle up at an angle above the level, such that when let drop the axle reaches the horizontal and rises again, and so on to a series of cusps.

This motion was illustrated on the gyroscopic apparatus exhibited, an ordinary 28-in. bicycle-wheel and hub screwed to a stalk, a short length of steel rifle-barrel, suspended in altazimuth freedom from a vertical spindle, another bicycle hub, fastened to an iron bracket, bolted to the underside of a wooden sleeper supported on brackets—not a thin lath, as I found them trying in Rome with the specimen I had sent to the Mathematical Congress in 1908. All details to be bought cheap or easily constructed.

The three angles, θ, ψ, ϕ, introduced into the treatment by Euler (1750), were shown in the altazimuth suspension: θ is the angle of the axle with the nadir downward vertical; ψ is the azimuth; while ϕ measures the rubbing angular displacement of the wheel over the axle.

The exact dynamical interpretation of ϕ is rather delicate in its relation to the rotation of the wheel about a moving axle. Thus, starting with the wheel at rest on the axle, we cannot turn it by twirling the axle. But move the axle round in a conical way back to rest at its original start, and we find the wheel has turned round on the axle through an angle ϕ proportional to the conical angle described by the axle. So here is an answer to the challenge of Aristotle: to turn a sphere round that is perfectly smooth, or spitted along a perfectly smooth diametrical axle.

In showing the θ and ψ displacement in altitude and azimuth, the wheel must be held to the axle by the thumb; as, if free, the angle ϕ will come into existence.

Anyone can show this off with a pencil or penholder held between finger and thumb.

The small bicycle-wheel is dismounted by removing the supporting pin, and can then be spun by hand as another top alongside the large wheel, or else superposed, as in Maxwell's experiment of the "top on the top of a top," thus forming two links of a gyrostatic chain, standing up like a *will o' the wisp*, which may be supposed in imagination to reach up to the ceiling, as a mechanical model of the electromagnetic rotary polarisation of light.

Sir William Thomson gave an elaborate mathematical investigation of the vibration and wave propagation, but this can be simplified and brought under elementary treatment by considering the gyrostatic chain as a uniform helical polygon rotating uniformly about the vertical, as I have explained in my Report on Gyroscopic Theory (1914).

Any similar discussion of a double pendulum, as of a bell and clapper, or a chain of links, is simplified in this manner by comparing the oscillation with a

[1] Abstract of a discourse delivered at the Royal Institution on May 3 by Sir George Greenhill, F.R.S.

steady revolving motion, throwing a shadow moving to and fro in plane vibration on the wall.

The bicycle-wheel forms a compound pendulum, with the axle held fixed, and put out of balance with an iron rod between the spokes; and then the wheel can show off oscillation of any finite extent, beating the elliptic function, or it can make complete revolutions, say from I to XI, or all round the clock.

For this experiment an ordinary bicycle complete will serve, laid on its back, using the front wheel, and then the hind wheel, to show off the effect of the inertia of the chain and crank-axle. The writhing of the frame on a smooth floor will illustrate the stress of reaction of the frame to the motion.

Prof. Perry has written a popular book on the "Spinning Top" in his most stimulating kindergarten style, but it is doubtful if he has ever seen a top of the size of these bicycle-wheels; and I wonder if he has ever seen this gyroscope apparatus, although I made him a present of one many years ago.

As in skating over thin ice the novice can progress swiftly, never stopping to look down at the black water underneath, whereas if he paused to consider the depth below he would break through and go down; so in the theory of the top the analytical difficulties would drown the beginner if not kept out of sight as long as possible.

The kindergarten explanation of the spinning-top is eloquent in answer to the beginner's question of the how and why. But in mathematical treatment it is the "how much?" That is the question.

Crabtree's "Gyroscopic Motion" goes more deeply into the mathematics of the subject in elegant treatment; and here is a Report on Gyroscopic Theory (1914) intended to serve for reference on the complete theory, where no analytical difficulty is avoided when any practical problem arises for solution. And the simple apparatus shown here is intended to be applied at once to a practical test of any new suggestion of harnessing a top or gyroscope.

Attention was directed to the deformable Henrici hyperboloid passing through the shape of a confocal system. This was employed by Darboux for the material representation of a state of top-motion by geometrical constants. Calculation was thereby replaced by measurement on a drawing.

Then there is Kirchhoff's kinetic analogue of the bent and twisted wire, to associate in making a mental picture of the top-motion in all its complexity.

This analogue states that if an elastic round wire, rod, or shaft is bent and twisted into its most general tortuous curve under the action of an equal opposing wrench at each end, the shape of the curve is such that if a point moves along the curve with constant velocity, the hodograph of its motion is a spherical curve, which can be identified as the curve described by a point fixed in the axle of a symmetrical top spinning about a fixed point, as in this small cup, and in the same period by a proper choice of the constant velocity.

In most practical applications the nutation is small and imperceptible, though never absent entirely, and the motion is apparently steady, with the axle at a constant inclination and moving round with uniform precession; in the Kirchhoff analogue the shaft is sprung slightly.

The curious property of a spinning body in rising erect in opposition to gravity, or of running along like a hoop or bicycle without falling over, has directed attention to the distinction between balance and stability according as it is statical or dynamical.

It was mentioned that Lord Kelvin, just twenty-five years ago, lectured at the Royal Institution on "Isoperimetrical Problems—Dido, or Making Things Spin," on a sheet of plate-glass fenced with a frame.

Since Newton compared himself with a child gathering pebbles on the shore, he set the fashion for his rivals of making them spin. But Newton took it for granted his audience knew he was quoting against himself the lines from "Paradise Regained":—

> Many books
> Wise men have said are wearisome.
> Who reads incessantly and to his reading brings not
> A spirit and a judgment equal or superior
> (And what he brings, what needs he elsewhere seek?)
> Uncertain and unsettled still remains,
> Deep versed in books, and shallow in himself;
> Crude or intoxicate, collecting toys
> And trifles for choice matters, worth a sponge,
> As children gathering pebbles on the shore.

In the contrast of balance, statical and dynamical, the C.G. in statical equilibrium seeks the lowest position it can find, but it rises as high as it is able in dynamical stability of balance, as of a sleeping top or bicycle. A top is said to sleep when spinning steadily upright; man or an animal sleeps lying down, with the C.G. low. But for ease of progression a man assumes the noble upright attitude of a biped, not on all fours, or rides upright on the back of a horse or high up on a bicycle. Any burden, rifle or knapsack, he carries as high as possible. Mounted still higher on stilts, his progress is not more difficult with the confidence of experience.

Confusion between statical and dynamical stability of balance has led to serious mistakes and misapprehension of theory, as of lowering the soldier's knapsack, or ballasting a ship too low and so making it uneasy among waves, as recommended by Euler; or spreading the railway gauge to lower the boiler and carriage-body between the rails, in Brunel's idea.

The modern locomotive is seen to-day high up over the wheels, as high as it can go under the old cramping limitation of the loading gauge of our bridges and tunnels.

A literary friend has directed attention to De Quincey's account of a wonderful brother, who claimed the power of rising against gravity to walk like a fly on the ceiling, provided with spin enough, but that he would require the flagellation of a whip-top in harness, emblem of fortitude in adversity.

> Tu ne cede malis, sed contra audentior ito.

Without attaining so far as the positive levity of De Quincey's brother, we have seen how a top can be made to climb a pole in the model described to the Royal Society by Mr. Tournay Hinde in their Proceedings. And Brennan can make it run along the tight-rope or on a single rail, concealed in harness inside a carriage, to which it gives the upright stability, acting automatically as the brain in riding a bicycle.

In the description of the American poet—

> Are you the Mr. Brennan makes gyroscopic tops
> To keep a car in balance when it runs, or if it stops,
> On single rail or wire rope that's stretched across a chasm?
> Pray write and tell me, Mr. Brennan, if you're the man that has 'em.

Axial stability of motion of an elongated body through the air, an arrow, bullet, or shell, is maintained by the gyroscopic action of the spin imparted by the rifling, and the calculation of the least amount required is a delicate question of dynamics. No more spin should be given than absolutely necessary, or the shell or bullet will be uneasy in flight, as a ship is uneasy among waves if bottom-heavy, as recommended by Euler, the weights stowed too low.

Passing from small to large applications, the Parsons turbine in the steamship requires to be treated on gyroscopic theory for motion among waves. Rolling does not affect them, but the internal stress due to pitching becomes important, and must receive investigation.

So, too, if electric dynamos are mounted with axle across the ship, they are very sensitive to the rolling, and are heard squealing and complaining as the ship rolls.

When a vessel proved a heavy roller, a cure could be made by fitting bilge-keels, but at a permanent loss of speed in all weather, rough or smooth, of a knot or two. Schlick's sea gyroscope will cure the rolling with no sacrifice of speed; it need not be put in action until wanted, and requires little power to keep it going.

The gyroscope consists of a heavy horizontal fly-wheel harnessed in gimbals, and controlled by a hydraulic buffer in the line of the keel. The damping action of the buffer can be regulated by a valve to suit the period of the waves, and it makes the flywheel react against the rolling and kill it out.

The inventor is said to have been offended when his apparatus was found more useful still in increasing the rolling and maintaining it, in the case of an ice-breaker, to worry a way easier through the pack or even in working off a sandbank. A different setting of the buffer valve was all required.

A spinning-top stands up vertical in a smooth cup even when the cup is moved about, as on a rolling ship, as we can show here with the Maxwell top; so that if the top carries a polished mirror across the axle, it can serve as the mercurial horizon does on *terra firma*, and so give an altitude when the sea horizon is obscured.

The idea was suggested by Serson in 1744, and the enterprising Admiralty of the day did not crab the idea straight off with the usual "won't work," but sent him to sea in the *Victory* to make a practical test; unfortunately the ship was lost with all hands on the Casquets, near Alderney.

A specimen from the King's collection is preserved in King's College, Strand. The idea has been revived of late years by French navigators as the Fleuriais gyroscopic horizon; it is claimed to give good results in skilful hands where an ordinary observation would be impracticable through fog.

But the most important service to navigation in recent times of the top in harness is the gyroscopic compass. The idea was suggested by Sir William Thomson, but the high spin requisite could not be realised in his day until the great improvement arrived in modern mechanical skill of an Anschutz or Sperry, as a steel flywheel was required, some 4 in. in diameter, spun at 20,000 revolutions a minute. The axle, mounted freely, is always striving after the position as close as it can get to the direction of the polar axis, and so carries the compass-card with it pointing due north, with no magnetic variation requiring constant correction.

Because in modern swift steamship navigation across the Atlantic, where the great circle course must be maintained, practically the only nautical observation required is for azimuth, in its correction of magnetic variation; and there is no variation in the gyro-compass. A specimen would be too complicated and delicate to show off in this room. And if any young researcher should take it into his head to test the action by pushing the card away from its course, it would take an hour or more to swing back into place again.

But the greatest spinning-top we know is this Earth itself, spinning round once a day, with the axis pointing near to the Pole Star. Ancient observation reveals a precession (as in the Maxwell top here, twirled with the left hand), so that the pole is making a circuit among the stars, which will be completed in 26,000 years. Since Homer's day the pole has made more than one-tenth of the way round, and the constellations have changed from one sign of the zodiac well back through the next, and beyond.

We are able thence to assign a date to Homer and Hesiod from their astronomical allusions. Thus the nymph Calypso gives Ulysses his final instructions how to keep off Africa before he sets sail on his raft from Gibraltar: "Never to let the Bear take a bath. He alone should be unsharing of the baths of Ocean," not setting below the horizon any star of the constellation. To-day these instructions would land Ulysses well ashore, some six hundred miles on Africa.

Ulysses could take his latitude with a piece of string, one end held up to the pole, and sliding the other finger to cover some well-known star, then sweeping the hand round to see if the star would graze the horizon, in which case the polar distance of the star is equal to the latitude.

Two such observations on different stars would fix his position, on Sumner's method, provided he had a chart; and Lord Kelvin amused himself on his yacht in testing the primitive methods of Ulysses and the old Greek navigators against the most modern instruments of observation, sextant and chronometer, with Nautical Almanac.

In the ancient tradition there was formerly no obliquity of the ecliptic, and the year was one perpetual spring. But after the Fall of Man, in the Greek legendary astronomical theory Milton has thrown into verse in "Paradise Lost"—

> Some say be bid his angels turn askance
> The poles of Earth, twice ten degrees and more,
> From the Sun's axle. They with labour pushed
> Oblique the centric globe.

No particular labour would be required, as we see with the Maxwell top, if only the polar axis projected, as the angel could move the poles by holding his finger against the axle and letting it run up. A reverse action at the Millennium will restore eternal spring.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—A generous offer made by Sir Basil Zaharoff, G.B.E., through the Air Ministry, to provide a sum of 25,000*l.* for the establishment of a chair of aviation has been accepted by the Senate with cordial thanks, and steps have been taken to secure a speedy appointment to the post.

New regulations have been adopted by the Senate under which extended facilities are offered to graduates of other universities, especially to students from overseas with suitable qualifications, to register as internal students and as candidates for higher degrees (except in medicine and surgery).

The following doctorates have been conferred:—*D.Sc. in Biochemistry:* Mrs. M. T. Ellis, an internal student, of the Physiological Laboratory and the South-Western Polytechnic Institute, for a thesis entitled "A Contribution to our Knowledge of the Plant Sterols." *D.Sc. in Chemistry:* Mr. L. H. Parker, an internal student, of the Imperial College, Royal College of Science, for a thesis entitled "(i) Reactions between Solid Substances, and (ii) The Interaction of Sodium Amalgam and Water." Mr. O. C. M. Davis, an external student, for a group of papers dealing with steric influence and other subjects. *D.Sc. in Statistics:* Mr. Alexander Ritchie-Scott, an internal student, of University College, for a thesis entitled "(i) The Correlation Coefficient of a Polychoric Table, and (ii) A First Study of Polychoric Functions and the Incomplete Moments of a Normal Correlation Surface." *D.Sc. (Engineering):* Mr. James Montgomerie, an internal student, of the West Ham Municipal Technical Institute, for a thesis entitled "Stress and Strain Conditions in Rectangular Flat Plates Fixed at the Edges and Exposed to Uniform Pressure over Surface."

THE New York correspondent of the *Times* announces that a legacy of 3,000,000*l*. has been bequeathed to Yale University by the will of Mr. J. W. Sterling, who died suddenly on July 5. Mr. Sterling graduated from Yale in 1864.

MR. R. DOUGLAS LAURIE, who has been chief demonstrator and assistant lecturer in zoology and lecturer in embryology in the University of Liverpool for some years, has been appointed head of the department of zoology in the University College of Wales, Aberystwyth.

A FEW days ago a meeting was held at the Cardiff Exchange to consider the means of development of technological institutions, and the suggestion was then made that a sum of 50,000*l*. a year should be raised by the industrialists of the district. A beginning has been made in this direction by a contribution of 25,000*l*. from Lord Glanely towards the cost of a chemical laboratory, to be known as the Tatem Laboratory, in the University College of South Wales and Monmouthshire, Cardiff. In making this princely gift Lord Glanely remarks that the laboratory is the first step in a scheme essential both to the welfare of the college and the industrial community of South Wales. He adds:—"I understand that for the completion of the scheme in a manner worthy of a great industrial area a sum approaching 125,000*l*. is required, and I trust my contribution may be regarded as but the first step towards the accomplishment of this great undertaking. Slowly, but, I believe, surely, the industrial community is awakening to the importance of science and its application, and also to the necessity for its encouragement if we are to hold our own in the difficult times which are ahead of us. I am aware of the efforts made by Principal Griffiths to further the closer union of science and industry and to promote the cause of research, especially in those branches which most affect our local industries. It is, therefore, my earnest hope that his successor may be one who will realise the vital importance of this matter, and has the training and knowledge which will enable him to appreciate the problems which must be faced, and complete the work of which the foundations have now been laid."

THE University of London proposes to establish a degree in commerce. The scheme, to be really effective, must be worked out as a whole with an independent organisation, not as a mosaic of fragments built up from various faculties. The needs of the teaching depend on the aim of the degree course and the type of student for which it is intended. Finance and commerce in the broadest sense are the main interests of London, and likely to provide the mass of the students. The training should be correlated to the main interests of the individual, though in no sense a substitute for actual experience of business. Elementary economics, geography, and accounting, together with a thorough knowledge of a modern commercial language, with the addition of certain optional subjects, such as a science, or mathematics, or history, would provide a broad basis for more specialised work. The broad facts of commercial and financial organisation, recent historical development of the great commercial Powers, and the main principles of commercial law are of importance to all. Beyond these are two groups of subjects: on one hand, business organisation, the banking and financing of production and trade, and the movements of capital; on the other, the industrial and commercial conditions of the great markets of the world. Mr. A. J. Balfour, on July 18, spoke at a meeting at the Mansion House called to support the scheme of the University. He pointed out the two main criticisms that would be brought against degrees in commerce, one by those who argue that academic training is of little value in the actual practice of life, and the other by those who argue that vocational education is narrowing, and, indeed, may be so narrow as not to be education at all. He remarked that few subjects have so many aspects and so much human interest as the many-sided life of commerce.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 27.—Sir J. J. Thomson, president, in the chair.—Prof. T. H. **Havelock**: Periodic irrotational waves of finite height. It is shown that an extension of Michell's analysis for the highest wave gives a method which includes waves of any permissible height.—Dr. G. N. **Watson**: The diffraction of electric waves by the earth. Approximate formulæ have been obtained by Poincaré, Macdonald, Nicholson, and others, which express the disturbance due to a Hertzian oscillator at a distant point of the earth's surface. This paper contains a transformation of the series for the magnetic force into a series which converges very rapidly except in the immediate neighbourhood of the oscillator.—Dr. A. D. **Waller**: Concerning emotive phenomena. Part ii. Periodic variations of conductance of the palm of the human hand. This paper gives an account of further observations of changes of electrical resistance associated with emotive phenomena. Their physiological lost time is between two and three seconds, and occurs principally in the skin (palm of hand). With higher and lower conductivity the effects are greater and smaller. The electrical conductivity (palm of hand) exhibits a diurnal periodicity concurrent with the waxing and waning of physiological activity during the twenty-four hours.—Prof. J. A. **MacWilliam**: The mechanism and control of fibrillation in the mammalian heart. An essential condition in fibrillation is an altered (fascicular) mode of conduction. This may characterise even single beats as "fibrillar." The production of a rapid, continuous series of contractions in typical fibrillation depends on a disturbance in the normal relations of conduction time and refractory period, leading to the establishment of a mechanism of circulating excitations. Gradations are traced between fibrillar beats and rapid fibrillation. The chief protective and remedial agents described are urethane, adrenaline, strontium chloride, hirudine, and pilocarpine. The action of the last may reproduce the different actions of the vagus in auricles and ventricles respectively, promoting fibrillation in the former and restraining it in the latter.—Dr. J. F. **Gemmill**: The development of the sea anemones, *Actinoloba dianthus* and *Adamsia palliata*. An account is given of the development of these anemones from fertilisation to the eight-mesenteried stage. In both species the eggs are relatively small, those of Actinoloba containing so little food-yolk that the free-swimming planula feeds by the action of cilia on two precociously formed mesenteries (the future sulco-laterals), and afterwards crawls mouth-downwards with stomodæum everted, presumably obtaining food from the substratum. This is the only known instance of a feeding Actinian planula, and, indeed, the only previous detailed account of anemone development is that of Appellöf for Urticina, which has large yolky eggs.—

R. **Beer** and Agnes **Arber**: The occurrence of multinucleate cells in vegetative tissues. Binucleate or multinucleate cells have been observed by the authors in 174 plant species belonging to fifty-nine families. They have been found in each of the five classes of living Pteridophyta, in Gymnosperms, and in Angiosperms. They occur in a wide range of tissues belonging to stem, root, and leaf. The multinucleate condition has, in all cases, been found to arise by mitotic division of the nucleus, and in no instance have amitotic divisions been seen to play a part.—Dr. J. H. **Mummery**: The epithelial sheath of Hertwig in the teeth of man, with notes on the follicle and Nasmyth's membrane. The author shows that the "epithelial sheath of Hertwig" is present as a complete organ in human teeth, and, as shown by von Brunn in many mammalia, is the moulding or limiting organ of the dentine of the root, being constantly present where dentine is being deposited.—H. H. **Jeffcott**: The periods of lateral vibration of loaded shafts. The rational derivation of Dunkerley's empirical rule for determining whirling speeds. This paper deals with the periods of lateral vibration of loaded shafts, and gives the rational basis of Dunkerley's empirical method for determining the first whirling speed of a shaft carrying a number of loads. Results obtained by the Dunkerley formula are compared with the exact solutions in a few simple cases. The method employed is of general application, and leads to a theorem connecting the several speeds of vibration of a system of masses elastically connected with the speeds of vibration of the partial systems obtained by reducing to zero a given number of the masses in turn in all possible combinations.—Prof. Norman **Collie** and Dr. H. E. **Watson**: The spectrum of cadmium in the inactive gases.—C. F. **Brush**, Sir Robert **Hadfield**, and S. A. **Main**: Further experiments on spontaneous generation of heat in recently hardened steel.—T. **Matsushita**: The slow contraction of hardened carbon steels.

DUBLIN.

Royal Dublin Society, June 25.—Dr. G. H. Pethybridge in the chair.—Dr. F. E. **Hackett**: The twist and magnetisation of a steel tube in a spiral magnetic field. This paper deals with the verification of a formula given by Knott in 1888 relating the Wiedemann effect to the Joule effect, viz. twist=length (radius)$^{-1}\sin 2\alpha(e_1+e_2)$, where e_1 and e_2 are the longitudinal elongation and transverse contraction in a given magnetic field. The theory was tested by keeping the spiral field constant and varying the pitch-angle α. Examination of the longitudinal magnetisation under the same conditions shows that the slight deviations observed from the expected linear relation of the twist to $\sin 2\alpha$ are due mainly to the demagnetising effects at the ends.—R. G. **Allen**: The absorption of water by vulcanised fibre and erinoid on exposure to moist air, and the consequent change of electrical resistance. Results were given for thoroughly dried samples of vulcanised fibre and erinoid which were immersed in nearly saturated air for measured intervals of time. The quantity of water absorbed was found to be approximately related to the time of immersion by a simple equation, and fibre was demonstrated to be much more hygroscopic than erinoid. Other results were given for these materials, showing the change of electrical resistance with quantity of water absorbed from moist air and the rapidity of decrease in resistance, especially in the case of fibre, with increase of this quantity. It was also shown that, whatever the quantity of absorbed water in fibre and erinoid, the same simple relation between temperature and resistance, common to many materials, including water, was followed in every case. The latter result was pointed out as giving strong support to the theory that electricity is conducted through the material of an insulator by the vehicle of water-films.

BOOKS RECEIVED.

Colour in Relation to Chemical Constitution. By Dr. E. R. Watson. (Monographs on Industrial Chemistry.) Pp. xii+197. (London: Longmans, Green, and Co.) 12*s.* 6*d.* net.

Wireless Telegraphy and Telephony: A Handbook of Formulæ, Data, and Information. By Prof. W. H. Eccles. Second edition, revised and enlarged. Pp. xxiv+514. (London: Benn Bros., Ltd.)

War Nursing: What Every Woman Should Know. Red Cross lectures by Prof. C. Richet. Translated by H. de Vere Beauclerk. Pp. xi+119. (London: W. Heinemann.) 3*s.* 6*d.* net.

Natural Science and the Classical System in Education. Essays New and Old. Edited for the Committee on the Neglect of Science by Sir Ray Lankester. Pp. ix+268. (London: W. Heinemann.) 2*s.* 6*d.* net.

The Practice of Soft Cheesemaking: A Guide to the Manufacture of Soft Cheese and the Preparation of Cream for Market. Fourth revision by C. W. Walker-Tisdale and T. R. Robinson. Pp. 106. (London: J. North.) 3*s.* net.

The War and the Coming Peace: The Moral Issue. By Prof. M. Jastrow, jun. Pp. 144. (Philadelphia and London: J. P. Lippincott Co.) 5*s.* net.

A Short Handbook of Oil Analysis. By Dr. A. H. Gill. Revised, eighth edition. Pp. 209. (Philadelphia and London: J. P. Lippincott Co.) 10*s.* 6*d.* net.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, AUGUST 1, 1918.

ARTIFICIAL LIMBS AND WAR INJURIES.

(1) *La Prothèse du Membre Inférieur.* Par Dr. F. Martin. Pp. viii+107. (Ambulance de l'Océan, La Panne.) (Paris: Masson et Cie, 1918.) Price 5 francs.

(2) *Troubles locomoteurs consécutifs aux Plaies de Guerre.* Par Prof. Aug. Broca. Pp. 155. (Paris: Masson et Cie, 1918.) Price 4 francs.

(1) IN the autumn of 1914, La Panne, the last village on the Belgian coast as one passes towards the French frontier and Dunkirk, consisted of a large hotel—Hôtel de l'Océan—and a number of lodging-houses, then crowded with refugees. It was to this site that the Queen of the Belgians summoned Prof. A. Depage, who, in peace time, was the distinguished occupant of the chair of surgery in the University of Brussels, but in the autumn of 1914, when summoned by his Queen, was busy establishing a military hospital in Calais. At the Queen's request Prof. Depage undertook to organise a field hospital in La Panne. He took over the hotel with its 150 bedrooms and surrounding villas; in a year's time he had more than a thousand beds at his disposal with laboratories and work-rooms attached. Under Prof. Depage La Panne became not only a beneficent institution for the relief of wounded Belgian soldiers, but also one of the great centres of surgical progress. In 1917 there began to be issued from the "Ambulance de l'Océan" a series of scientific publications, of which the excellent treatise here noticed is the latest number. Prof. Depage confided the difficult task of inventing, improving, and providing artificial limbs for mutilated soldiers to Dr. F. Martin. That he was fortunate in his choice there can be no doubt, for in his treatise on the "Prosthesis of the Lower Limb" Dr. Martin has produced a most useful and scientific contribution to a subject which medical men have hitherto totally neglected.

Up to the outbreak of war the United States was the only country in which the manufacture of artificial limbs had been seriously studied. When Dr. Martin commenced his investigations at La Panne he recognised the merits of the American models. But they were expensive, and had manifest defects in functional qualities and in adaptability. He saw that it was necessary to use a substance with all the qualities of seasoned wood, but one which could be moulded so as to form an exact socket or "bucket" for the stump of the amputated limb. He found the ideal substance in wood shavings cemented together by a particular form of glue. He saw that it was necessary that the artificial limb, so far as length of segments and axes of joints were concerned, must be a counterpart of the patient's sound limb. He invented a simple apparatus for obtaining the exact measurements required for the modelling of the artificial limb; he used the kinematograph to analyse the movements of the lower limbs in walking, and did not rest content until he found that his artificial limbs could simulate the movements of real ones. Thus he was able to improve on American models and to produce a more efficient article at a much lower price.

At La Panne certain useful principles have been laid down for the guidance of the surgeon when amputating and when treating the stump preparatory to the fitting of an artificial limb. At amputation the surgeon must leave as long a lever of bone as is possible; he must see that the muscles which are to move that lever are rightly placed and rightly fixed; he must see that the joint from which the bony lever is to act is free and movable. As the stump is shaped, the surgeon must foresee how the bucket of the artificial limb is to be given a sure support. At La Panne crutches are forbidden; their use is found to impair the mechanism of the body needed for the right use of an artificial limb. At the earliest date possible—in eight to twenty-four days, according to the nature of the amputation—the soldier is given a provisional limb—a "bucket" which is moulded to the stump, and remoulded as the stump atrophies—fitted to a wooden peg or stump. We have no doubt that the practice at La Panne—the practice of fitting out the maimed at once with provisional limbs instead of crutches—is right. We have, from reasons of space, had to omit any mention of Dr. Martin's original observations on the movements of the lower limbs in walking, but for those who are interested in the mechanism of walking, and wish to help in relieving maimed soldiers, we warmly commend this clearly and crisply written treatise from the "Ambulance de l'Océan."

(2) A British surgeon may well feel somewhat envious of the many excellent medical manuals which have appeared recently in France to meet the needs of the Army surgeon. The leaders of the French medical profession have placed their special experience, in the form of clearly and concisely written booklets, at the disposal of their colleagues in the field. In the booklet here reviewed Prof. Broca gives his experience and advice in the treatment of the various disablements which follow gunshot injuries of the limbs.

These are of many kinds and degrees—partial or complete fixation of joints, or disablements which follow injuries to muscles, nerves, or bones. In some respects the treatment adopted or recommended by Prof. Broca differs from that practised by the majority of British surgeons, but the underlying principles of treatment in both countries are the same. It is recognised that if permanent fixation or anchylosis of a joint is unavoidable, then the limb must be placed and kept in a position which will secure a maximum utility so far as the livelihood of the patient is concerned. In both countries it is recognised also—perhaps more so in Britain than in France—that the principles of treatment vary with the stage of recovery, complete rest by means of splints being the best treatment in the acute stages of the injury, and free movement the best medicine when the acute stage is over. Many French surgeons have a fear of producing permanent stiffness, even in a healthy joint, by immobilising a limb. Indeed, Prof. Broca shares this fear to some degree, and recommends that complete immobilisation of limbs should be practised only during transport of the wounded.

For the recovery of stiffened joints voluntary movements are recommended in preference to passive movements. Indeed, Prof. Broca is of opinion that in many slight cases of stiffness of joints a ten hours' day at manual labour is the very best treatment possible, so long as such exercise is not attended by positive pain. We note, too, that the author, in his introduction, gives the following quotation from Ecclesiastes as being true of orthopædic practice in France: "There is no remembrance of former things; neither shall there be any remembrance of things that are to come with those that shall come after." We in England are making similar discoveries; we find that many of our discoveries are really rediscoveries.

THE PARASITIC HYPOTHESIS OF TUMOURS.

Tumours: Their Nature and Causation. By Dr. W. D'Este Emery. Pp. xx+146. (London: H. K. Lewis and Co., Ltd., 1918.) Price 5s. net.

DR. EMERY'S book is remarkable in two ways. In the first place, it is a clear and concise statement of the parasitic hypothesis of the causation of new growths—a welcome innovation in a subject around which more dubious writing has been perpetrated than any other in medicine. In the second, it does not contain any original observations. After summarising and discarding the current definitions of "tumour," the author sets up three postulates to which the required parasite should conform—viz. ultramicroscopic size, intracellular or intranuclear habitat, and production of a toxin capable of stimulating growth in the invaded cells. The remainder of the work is devoted to a rapid review of the more prominent features of tumours, showing how they fit in with these assumptions. Benign growths are those with few parasites in each cell, giving weak action of the toxin; in malignant growths the cells are heavily loaded, much toxin is produced, and growth is energetically stimulated. At once we come in contact with the subsidiary assumption that the cells of the body grow only when stimulated. It is at least arguable and probably true that, on the contrary, growth goes on so long as life lasts. The contrast to the form of growth presented by the limited reactions to known toxins is got over by assuming a nicely balanced symbiosis of host-cell and parasite, the parasite not getting out of bounds and killing the cell, and the cell not being sufficiently irritated to kill the parasite.

Sarcoma development in the stroma of carcinomata (spontaneous or propagated) is regarded as a transference of the virus from the carcinoma cells to the connective tissue cells. The stroma of tumours is not, as the author says, merely granulation tissue, unless we admit also that the stroma of the pancreas, the liver, the lung, and the kidney is also granulation tissue. Although derived from the homogeneous, ubiquitous mesenchyme of the embryo, each of these organs has a characteristic stroma, and the same has been demonstrated for quite a number of carcinomata of the mouse and rat. In both cases they appear to be specific reactions of a single tissue to different parenchymata. The peculiarities of the process of sarcoma development, the long contact which is necessary, and the ultimate loss of the property are not touched upon. Perhaps they would involve too many and too intricate subsidiary assumptions.

The chapter dealing with the evidence from the organ-incidence of cancer shows the weakest side of the hypothesis. If we restrict our survey to cancer in man, as Dr. Emery does, the distribution appears rational, but it is otherwise when the tumours of animals are taken into account. Cancer of the mamma and of the uterus are common in man; cancer of the mamma is nearly as common in mice, but carcinoma uteri is very rare. Cancer of the stomach also is rare in mice, but common in the cow, while in this animal cancer of the mamma and of the uterus are both rare. Cancer of the liver is the commonest new growth in the cow and other herbivora. Next in frequency are new growth of the adrenal and carcinoma of the stomach. In the horse carcinoma of the liver is rare, while growths of the adrenal are common. The mouse and rat are closely related animals in structure, habits, and diet. Their new growths have a totally distinct organ and tissue incidence. To harmonise these well-known facts of the natural history of cancer with the hypothesis would require, not three fundamental assumptions, but nearer three hundred.

To be of value a hypothesis must fulfil two conditions. It must embrace without violence the facts of the subject and require a minimum of subsidiary assumptions. It must stimulate inquiry and lead to the extension of knowledge. Whatever shortcomings Dr. Emery's essay may have in the first direction are made up for in the second. It is safe to say that there is scarcely an assumption made of which it is only necessary to ask oneself, "Is this true, and how would you prove it?" to provide a subject for an interesting inquiry. Dr. Emery has rendered a great service to those engaged in the study of cancer. He has put into succinct and intelligible form the vague general impression which hitherto has hovered around the subject under the name of the parasitic hypothesis.

J. A. MURRAY.

THE WAR AND THE BAGDAD RAILWAY.

The War and the Bagdad Railway. The Story of Asia Minor and its Relation to the Present Conflict. By Prof. Morris Jastrow, jun. Pp. 160+1 map. (Philadelphia and London: J. B. Lippincott Co., 1917.) Price 6s. net.

EVERYONE has heard of the Bagdad Railway, and that its project for capturing the trade of the East was one of the chief causes which led Germany to contrive the present war; but few know the inner history of this project. This want is now well supplied by Prof. M. Jastrow, the well-known professor of Semitic languages in the University of Pennsylvania, and his exposures fully justify President Wilson's informed statement that this railway was "the heart of the matter" in the long-planned German arrangements for this war, and that "it is the bulk of German power inserted into the heart of the world."

The railway, intended to connect Constantinople and Bagdad, stretches across Asia Minor along one of the most historical highways of the ancient world. The scope of the story told by Prof. Jastrow and his interesting style are well seen in the following extract, which also summarises the scope of the book:—

"The purpose of this volume is to elucidate an aspect of the war which, although overshadowed at present by the paramount issue—the menace of a militarism in league with autocracy—was the most significant factor contributing to the outbreak of the long-foreseen war in 1914, and will form one of the most momentous problems when the time of the peace negotiations arrives. Ever since the announcement was made towards the close of the year 1899 that the Turkish Government had conceded to a German syndicate the privilege of building a railway to connect Constantinople with Bagdad through a transverse route across Asia Minor the Bagdad Railway has been the core of the Eastern question. There were, to be sure, other aspects of that question, which led to the two Balkan wars of 1912 and 1913, but the addition of the Bagdad Railway was an aggravating factor to an already sufficiently complicated situation, that involved the great European Powers—England, France, Germany, and Russia—in a network of diplomatic negotiations the meshes of which became closer as the years rolled on. The railway became the spectre of the twentieth century. It was a spectre that always appeared armed 'from tip to toe,' and when occasionally he 'wore his beaver up' the face was that of a grim, determined warrior."

Numerous excellent photographic illustrations give vivid glimpses of the scenery along the line of the railway and several of its bridges and mountain tunnels; and there are historical and archæological notes by the way, from classic down to Crusading times, with a good, useful, and up-to-date map. L. A. WADDELL.

OUR BOOKSHELF.

How to Enlighten our Children: A Book for Parents. By Dr. Mary Scharlieb. Pp. v + 202. (London: Williams and Norgate, 1918.) Price 3*s*. 6*d*. net.

WE welcome this very useful little book on the vexed question of how to educate children in regard to their physical nature and its development. As Dr. Scharlieb says, the difficulty lies not so much in the shy reluctance of parents as in their absolute ignorance of what they ought to teach, and she here sets forth simply and straightforwardly the main facts the parent must know in order to guide the child aright.

A brief chapter on the child in the pre-pubertal stage is followed by an account of the reproductive organs and their functions in girls, the changes that take place at puberty, and the commoner physiological difficulties that may arise. Much wise advice is given to mothers on the need for sympathetic watchfulness during this period of physical transition, with its influence on the moral and spiritual nature. In the succeeding section the boy with his particular difficulties is dealt with in the same way, and a chapter is devoted to the special instruction he needs at the onset of puberty.

"How Life is Transmitted" gives an account of the beginnings of life in the plant and animal world. This is necessarily slight, but it is sufficient to indicate the way in which teaching of the biological facts of sex at a stage when they are still external to the child's mind may be used as a safe foundation for personal sex instruction when that comes to be necessary.

The last section of the book is devoted to the social aspect of the sex question—the dangers to which young adults of both sexes are exposed under modern industrial conditions, the "social evil" and how to combat it, and the value as a safeguard of continual insistence on the eugenic point of view.

Acoustics for Musicians. By Prof. P. C. Buck. Pp. 152. (Oxford: At the Clarendon Press, 1918.) Price 7*s*. 6*d*. net.

THIS text-book is intended to present to music students the scientific basis of their subject, and to many such students probably any science is somewhat difficult, even that with which they are most concerned proving no exception. Accordingly, the author of such a work undertakes a hard task; but in the present case its difficulties have been tackled with sympathy, insight, and skill. The result is a work which should prove welcome to those who, though their chief interest lies in the music itself, must acquire some knowledge of the scientific principles underlying it.

The book is divided into six parts, dealing respectively with production of sound, pitch, intensity, quality, temperament, and transmission. The sixth part includes chapters on combination tones, consonance and dissonance, and the human ear. The fifth part has a chapter on the equal and mean-tone temperaments. This subject is treated from the musician's point of view, and its inevitable mathematical difficulties are reduced to a minimum.

In a work otherwise so excellent it is regrettable that, in the diagrams of wave curves, *circular* arcs usually occur instead of true *sine* graphs. But this is practically the only blemish in a book which is to be heartily commended for its accuracy and lucidity. E. H. B.

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 Problem of Man's Ancestry.

HAVING read Prof. Wood-Jones's booklet, "The Problem of Man's Ancestry," reviewed in NATURE of June 27, p. 322, it seems to me that Prof. Wood-Jones's assertion that man, instead of being the descendant of the apes, may be looked on as their ancestor contrasts with what the author himself writes on the premaxillary bone (p. 36). If man, who is the forerunner, has lost the individuality of the premaxillary element (which is not present in the human embryo, according to the author), how is it that it is found in the apes? It cannot be a new acquisition, because the premaxillary bone is already found in primitive mammals. Therefore apes have this primitive characteristic instead of man.

As to the judgment of the late Hermann Klaatsch that "man and his ancestors were never quadrupeds as the dog or the elephant or the horse," I think it was superfluous already when written by Klaatsch, as no one then accepted such a view; it is, therefore, not worth Prof. Wood-Jones's while to repeat it, especially as this judgment does not at all say that man was not an ape.

Klaatsch only said that the anthropoids were attempts which had failed, and that man was the successful attempt (this, too, is a fairly banal idea); but he never denied the affinity between man and the Simiidæ. On the contrary, his last scientific opinion was an exaggeration of such an affinity, the so-called "pan-anthropoid theory," already criticised by Prof. Arthur Keith and myself.

V. GIUFFRIDA-RUGGERI.

Istituto di Antropologia, R. Università, Napoli, July 14.

I THINK that Prof. Giuffrida-Ruggeri has somewhat misunderstood my meaning, for naturally I have never asserted that the premaxillary element is not present in the human embryo. All I have ever ventured to state is that "it has ceased to exist *as a separate entity on the human face*," and that this state of affairs is brought about remarkably early in the embryo. This I have alluded to as "a human specific character," a specialisation from that primitive mammalian condition which is still retained in all the rest of the Simiidæ, and I see nothing illogical in assuming that the mammal which possesses this specialisation is yet more akin to the primitive mammalian condition than are those animals which, lacking this particular character, exhibit a host of other features which we know to be departures from the primitive mammalian plan. It is upon a summation of characters that we must judge of the animal's zoological position, and my point is that, when such a complete survey is made, the balance of primitive mammalian features is found in the body of man, and not in the body of the monkey. I need scarcely say that I have never "denied the affinity between man and the Simiidæ," but I have insisted upon a proper recognition of the differences between the anatomical structure of man and the Simiidæ.

Two classes of criticism have been levelled against my very humble pamphlet. The one, typified by the review in NATURE, names it and condemns it as "a new hypothesis as to man's origin"; the other, on the lines of Prof. Giuffrida-Ruggeri's last paragraph, assumes that it has all been so long generally accepted that it is "not worth while to repeat it." Since these two types of criticism tend to neutralise each other, I have hitherto refrained from discussion; but if Prof. Giuffrida-Ruggeri imagines that no one believed, even when Klaatsch wrote, that man's ancestors were pronogrades, he should read the review in *Man* (No. 71, 1916), written by a well-known comparative anatomist, who "is, and has long been, convinced of the pronograde ancestry of man."

F. WOOD-JONES.

LICE AND DISEASE.

TYPHUS fever and the relapsing fever of North Africa are now both known to be transmitted from man to man by *Pediculus humanus,* and for this reason have been in past centuries perhaps the two most characteristic epidemic diseases of overcrowding and poverty, and during wars have attacked beleaguered cities in particular. A third disease, known in the British Army as trench fever, has recently been definitely proved to be conveyed by lice. In Germany this same disease is called *Febris volhynica* or *Febris quintana.* The especial association of the disease with life in the trenches was early noticed, and helped to bring lice under suspicion.

The German Army first recognised the disease in Volhynia, a region of South-West Russia; but it is said to have been previously known to Polish doctors. Cases of the disease were not noted in Mesopotamia, Egypt, or the Mediterranean area until the close of 1916. The disease is thought to have been introduced into Greece by chronic cases which arrived at Salonika from France in the winter of 1916–17.

The first published clinical account of the disease was by Major J. H. P. Graham in September, 1915, and since then much has been written on the subject. The first published attempt to investigate the pathology of trench fever was that by McNee, Renshaw, and Brunt. Two varieties of the disease were described by these authors, who showed, by a series of observations on volunteers, that it could be transmitted from man to man by taking blood from a patient during, or immediately after, an attack of the fever, and injecting it into a healthy man. The red-blood corpuscles especially were suspected of harbouring a causative micro-organism, but microscopical examination did not result in the discovery of a parasite. The virus was not conveyed by filtered serum or plasma.

Trench fever is still responsible for a very large share of the sickness in the Expeditionary Forces in France. Our knowledge of this disease has been summed up in a paper read before the Society of Tropical Medicine and Hygiene on May 17 last by Major Byam, who has had exceptional opportunities of studying cases at the New End Military Hospital, Hampstead.

Three chief obstacles to the investigation of the disease are (1) its frequently mild, indefinite, and irregular clinical course, with the consequent difficulty in diagnosis; (2) our lack of knowledge as to the nature of the infecting virus; and (3) the difficulty, if not impossibility, of infecting experimental animals.

When the two cardinal features of the disease are present—*i.e.* the characteristic relapses of fever, occurring at fairly regular intervals of four, six, seven, or ten days, and severe pain in the lower part of the shins—its recognition is fairly easy, but in numerous cases only one or neither of these symptoms is present, and diagnosis has to depend on a general survey of the clinical symptoms. The causal micro-organism is unknown; though a spirochæte, a hæmogregarine, a bacterium, or a Rickettsia body similar to that described as the cause of typhus fever has each its advocates.

A few experiments on the transmission of trench fever by the louse were made before 1918, but the evidence published is scanty. Weldon and Davis allowed two lice to bite each of them after first starving the insects, and then feeding them on a trench-fever patient. Weldon developed the disease after eighteen days. The evidence for the transmission by these lice is, however, not quite convincing. Nankivell and Sundell failed to transmit by feeding lice and doubted the hypothesis of transmission by these insects.

In October, 1917, the American Red Cross Society, in conjunction with representatives of the British Expeditionary Force, formed a committee to investigate trench fever. This body has carried out much very valuable work, but its full report has not yet been made.

About the same time a War Office Committee, under the chairmanship of Major-General Sir David Bruce, was formed in England, in order to advance the knowledge of trench fever with a view to its prevention, and the research in progress at Hampstead was merged in that of the Committee, of which Major Byam became a member.

Up to the close of the year the work was confined to the study of clinical evidence, the examination of the blood and urine of patients, together with the feeding of lice on them during their febrile periods, followed by the subsequent microscopical examination of the insects with a view to the discovery of the infecting organism.

With the commencement of 1918, thanks to the financial assistance of the Lister Institute and the courageous and patriotic action of a number of volunteers, it became possible to widen the scope of the research, and very valuable results speedily followed. A confirmation was obtained of McNee's main results of direct inoculation from patient to patient by blood, and the problem of transmission by the louse was seriously attacked. The Committee was fortunate in having at its disposal ample stocks of lice, free from suspicion of previous infection, which had been reared under the direct supervision of Mr. Bacot, entomologist to the Lister Institute.

The first experiments in which the insect vector was concerned consisted in two of the volunteers submitting themselves to the bites of several hundred lice daily, the insects having been previously fed on patients during febrile periods both before and during the month of experiment. The lice, therefore, had many opportunities of becoming infected, and the men received the bites of these lice three times each day for thirty days. Neither showed any of the symptoms of trench fever.

Next, following the analogies of relapsing and typhus fevers, two volunteers were inoculated from lice which had fed repeatedly on trench-fever patients. In both the inoculation was made by scratching the skin and rubbing in, eleven crushed lice in one case, and excreta voided by the lice in the other. Both men developed typical symptoms of the disease, with a relapse in six to eight days. The inoculation of louse excreta into scratches has been repeated a number of times, and in every case an attack of the disease has resulted.

It was found that the incubation in man, when infected by scarification, was remarkably constant, *i.e.* six to eight days, and the ease and certainty with which infection could be produced pointed to the inoculation of the contents of crushed lice or louse excreta as in all probability the common, if not the invariable, method of transmission.

The excreta obtained by shaking through the gauze cover of the boxes in which the lice were confined were used in the form of a dry powder, which remained infective for at least sixteen days. In parallel experiments with the excreta of normal lice which had not been fed on trench-fever patients no symptoms of the disease were produced.

That a very small amount of blood, such as might be contained in ten lice, does not directly convey the disease through an excoriation of the skin, is indicated by the negative result obtained by rubbing 5 c.mm. of infective blood into scratches on the skin of a volunteer.

Moreover, the following series of experiments points to the fact that the louse, after a meal of infected blood, does not void infective excreta for some days. Lice were fed on a trench-fever patient on one day only, and then on healthy men. Excreta collected on the first, third, fifth, and eighth days after infection gave negative results, while those collected on the twelfth and twenty-third days proved virulent. The virus, therefore, would appear to undergo some preparation in the insect before it becomes infective. Whether this change in the louse is due to a simple multiplication on the part of the hypothetical micro-organism, or to a cycle in its development, is as yet undetermined. Further, it was shown that the ingestion of louse excreta did not produce trench fever in two men who daily swallowed a dose for seven and fourteen days respectively.

Incidentally, the transmission experiments by McNee and at Hampstead have proved that the different clinical types of the disease are really due to the same infective virus. The disease may persist in man for a very long period. A case is recorded by Hurst lasting about six months, and relapses have occurred in men who have been more than eight months in England, while the infectivity of the blood of a patient has been proved as late as the seventy-ninth day from the initial attack.

With the certainty of the transmission of trench fever by lice the problem of how to check lousiness in the Army becomes urgent. What was previously a question of the comfort of our troops now becomes a matter of curtailing a heavy wastage of man-power from a preventable cause. It is to be hoped, therefore, that adequate steps to deal with body vermin will be instituted.

ADDENDUM.

Three varieties of lice attack man; two of these, *Phthirus pubis* and *Pediculus humanus* (*capitis*), are associated with hair, and the third, *Pediculus corporis*, with clothing, the body hairs serving as an occasional and final stronghold for the species. By close clipping of all hair at regular intervals the two first-named species may be finally disposed of, but the more difficult problem of dealing with clothing and bedding infected with *Pediculus corporis* remains to be dealt with.

Heat is still by far the most effectual and economical method of ridding infected fabrics of lice. An exposure for twenty minutes to 55° C. (131° F.) is sufficient under practical conditions, provided bundling is not resorted to. Three methods of utilising heat are applicable:—

Dry heat is the easiest, simplest, and most economical.

Steam requires a more elaborate and expensive equipment with a higher working cost; it is impracticable to work with it at temperatures below 65°–70° C. In the case of bundled articles the temperature for both methods should exceed 100° C.

Hot water is applicable to undergarments only, and does not require any chemical addition provided its quantity and temperature are adequate to the bulk of the garments dipped.

Vapour.—Sulphur dioxide (SO_2), as supplied by the Clayton gas apparatus, is expensive, both as regards plant and working cost, slow in action, and needs skilled management to maintain the necessary concentration, while even in experienced hands it may allow of the survival of a small percentage of nits.

Hydrocyanic acid gas is dangerous to generate, and its use, except with skilled management, is to be deprecated; its effect on lice and nits appears to be slow, but has not been adequately determined.

The vapours of volatile fluids or substances, such as benzene, xylol, petrol, etc., may be employed if air-tight containers are available; that of naphthalene is also applicable for use by this method.

Fluids.—Light oils, such as kerosene, give fairly trustworthy results if the period of immersion is long enough, and if their efficacy against nits is aided by the addition of a small percentage of some essential oil, such as oil of sassafras. More volatile fluids are effective against active lice, but may fail against nits if the period of immersion is short.

The most trustworthy and generally serviceable fluids to use for the destruction of nits in clothing would seem to be emulsions in water of soap and crude carbolic acid, cresol, tar or wood oils, which readily destroy both active lice and their nits. The strength of the solution and period of exposure are interrelated factors—five minutes' immersion in 2 per cent. lysol being adequate, provided the temperature of the solution is above 5° C.

The impregnation of undergarments with such solutions offers a hopeful chance of aiding any general scheme by coping with the difficulty of dealing with the front line and special posts, which form the main sources of the infection of clean troops. Up to the present, however, the experiments in the field, which are necessary before a final decision on the value of this process can be arrived at, have not been carried out by the authorities.

Finally, there is the personal use of insecticidal preparations as aids to the primitive method of getting rid of these pests—now referred to as "chat"-hunting. To be of service the preparation should be of quick action and easy of application to clothing, and its issue should be as general and comprehensive as that of food. Preparations in the form of pastes are more economical and convenient than powders; fluids are out of the question. Crude "unwhizzed" naphthalene, produced by coke-oven plants, affords the most effective base, and may be conveniently mixed into paste form by the addition of soft soap or some grease, such as vaseline, in the proportion of 10 to 20 per cent. It is suitable only for clothing, and should not be employed on the skin. When it is necessary to use an anti-lice preparation on a hair-clad surface the use of vaseline, to which has been added ½ per cent. of veratrine dissolved in 5 per cent. of benzene, may be recommended.

AGRICULTURAL RECONSTRUCTION AFTER THE WAR.

IN August, 1916, Mr. Asquith appointed a Sub-Committee of the Reconstruction Committee, under the chairmanship of Lord Selborne, to inquire into the subject of agricultural development after the war, and this body, having heard a considerable amount of evidence, has now issued its Report (Cd. 9079, price 1*s*. 3*d*. net). The recommendations cover practically the whole field of agriculture, and they have the double merit of boldness and consistency.

In a historical introduction it is shown that agriculture was very prosperous during the Napoleonic wars, but suffered a period of depression afterwards. Between 1832, when the Reform Act was passed, and 1846, when the Corn Laws were repealed, the political advantages of landed property were steadily being abolished, but on the other hand some of the farmers' grievances—the old Poor Laws, the tithes, statute labour for minor roads, bad markets and means of communication—were also dealt with. Still more important, from the year 1843 Science began to lend her aid and to teach the use of artificial fertilisers, more efficient implements, and better varieties of crops. From 1837 onwards came a period of rising prosperity, culminating in the 'sixties and early 'seventies, which are generally regarded as the golden age of agriculture in this country.

In 1875, however, a period of depression set in which was acute until 1884 and again became serious in 1893. Several factors operated. Speculation had taken some of the farmers' and landowners' reserves of money; there was a series of bad seasons, culminating in the disastrous year 1879; American wheat and meat began to arrive in quantities, driven here by the financial troubles of the West and transported in the new cargo fleets then being constructed. The Government ordered inquiries, but did nothing; the political philosophy of the day was *laissez faire*—so long as food was cheap it mattered nothing if farmers went bankrupt and agriculture were ruined. Farmers and landowners struggled manfully against adversity, but many went under; the period was one of the saddest and most tragic in our rural history.

It was soon realised that grass farming was cheaper and less risky than arable farming. Between 1870 and 1900 the area of arable land in the United Kingdom fell from 24 to 19·5 million acres, and the pasture land rose from 22 to 28 million acres. At the beginning of the present century prices began to rise and farming to mend, but the farmer had learnt that he must depend on himself alone, and so he followed a system of husbandry which involved the minimum of risk and gave the maximum of return for the capital employed.

When war broke out it became apparent (as, indeed, experts had long realised) that grass farming, while beneficial to the individual, is not specially beneficial to the State. It does not produce anything like so much food per acre as arable land, and in particular it does not yield the bulk of cheap carbohydrate and protein that the nation needs. To the *laissez-faire* politician this did not matter; to a nation at war, however, it was vital.

The Committee draws from this historical review the general conclusion that the British farmer will not grow corn to any large extent unless he has some confidence that prices will be sufficient to repay expenditure. Agriculture is a business run for profit like any other business. On the political system in vogue at the end of last century the farmer gave up grain production because he had no guarantee that prices would remain at a remunerative level: they might always fall below the 34*s*. or thereabouts which it then cost to grow wheat. If the nation requires wheat to be grown here (and if it does not, "our reference is misleading, our opinions are erroneous, and this Report is waste paper"), the Committee insists that this risk of unremunerative prices must be borne by the community. Of course the farmer must in return accept certain responsibilities; he cannot guarantee delivery of so much wheat, because of the dominating influence of the seasons, but he can at any rate be compelled to raise his standard of farming and to pay decent wages. This recommendation has already been adopted and passed into law; unfortunately, the Committee states, the Act is a war-time measure only, and cannot have its full effect unless it becomes a permanent statute.

This is the central feature of the Report. Assuming it is carried out, the Committee makes further important recommendations. First, it asks for a survey of the condition of agricultural land throughout the kingdom from the point of view of its utilisation for food production, and it recommends that the Board of Agriculture shall have the power of temporarily superseding landowners or dispossessing tenants in case of bad management. More cottages should be erected, and more definite steps taken to encourage the growth of sugar-beet. The Development Commission should no longer be barred, as at present, from making advances to associations trading for profit. Alongside all this must go greater provision for agricultural education and research work. The United States spends above 4,000,000*l*. annually on agricultural education and research; France more than 1,000,000*l*.; Canada, 840,000*l*.; Prussia (in 1910), 490,000*l*.; but the United Kingdom only about 310,000*l*.

The Committee was very sympathetic to research work and agricultural education, as was only to be expected from its *personnel*. "The research work already being done," it says, "is quite admirable, but it needs stronger support yet from public funds. We reiterate that this is public expenditure which will bring in to the State a manifold return." "The evidence that has been laid before us has amply shown the ultimate value of pure scientific research and the dependence of the development of the industry upon investigation that is independent of any apparently immediate practical end." It is further clearly recognised that the old policy of underpaying the workers is futile and uneconomical. Some of the best workers are attracted to the Colonies and Dependencies.

With refreshing vigour the Committee insists on the absolute necessity for ample provision for education. The system of agricultural education in England and Wales is found to differ from the Irish or Scottish, and in the judgment of the Committee is less effective. The scheme itself is sound and provides a thoroughly good groundwork for expansion, but the execution is faulty. Too much is left to the discretion of the county councils, which can carry out or shirk their responsibilities as they please.

Rates and votes are the main excuses for inaction, and these can be very potent. The Committee urges that the responsibility for agricultural education in England and Wales should be definitely placed on the Board of Agriculture, which should take over existing staffs, colleges, and institutes from the county councils and run them out of Imperial funds and not out of the rates. If this were done much of the prejudice against agricultural education would undoubtedly disappear. Further, the Committee recommends that an improved ruralised curriculum for elementary and secondary schools should be laid down, and better prospects provided for rural teachers. Existing farm institutes and colleges should be developed so as to afford adequate opportunities for higher education to all who desired it. The present system of small demonstration plots should be extended; there should be demonstration and illustration farms where new and improved methods of farming could be shown as part and parcel of the actual system of farming. The method is found useful in Canada and might well be tried here. A certain number of large farms should be established on purely business lines, but open to inspection, and giving publicity to their methods and accounts. In the opinion of the Development Commissioners the influence of these farms on agriculture (always supposing them to be financially successful) would be remarkable.

The Report is comprehensive and singularly opportune. Never before in our time has there been so grand an opportunity for laying the foundation of a noble rural civilisation. The touch of sadness brought into most homes by the war has done much to broaden our outlook and to level old prejudices. The problem must be approached in an enlightened but sympathetic spirit, looking only to the welfare of our children and our children's children; it can be solved, and the Report before us furnishes suggestive lines on which a solution can be found. E. J. RUSSELL.

PLATINUM.

A FEW months ago we noticed (vol. c., p. 486, February 21) the chapter on "Platinum in 1916" which Dr. G. F. Kunz contributed to the current volume of "The Mineral Industry," and now we have before us in pamphlet form the illustrated article on the same subject, though studied from a somewhat different point of view, which the same writer penned for the issue of the Bulletin of the Pan-American Union for November, 1917. On the last page—and, therefore, there being no cover, the back of the pamphlet—we are told that this union is an international organisation, which is housed at Washington in a beautiful building provided by the munificence of Mr. Andrew Carnegie, and is maintained by the republics, twenty-one in number, in both the Americas, the necessary funds being provided by the several countries in proportion to their population. The administration is in the hands of two executive officers—Director-General and Assistant-Director—who are appointed by, and are responsible to, the Board of Governors, which comprises the United States Secretary of State and the diplomatic representatives at Washington of the other American Governments, and they have the assistance of an ample staff of experts in various subjects, statisticians, translators, librarians, clerks, etc. The purpose of the union is to develop commerce and to promote friendly intercourse and good understanding between the several States—an admirable object that might with advantage be extended when opportunity occurs at the close of this tragic war.

The extraordinary rise that has during recent years taken place in the value of platinum is too well known to need emphasising, but it may not be without interest to note that in 1828 so little was it valued that the Russian Government commenced to coin of it 3-, 6-, and 12-rouble pieces. These coins would, according to present prices, be worth intrinsically about twenty times their nominal value. Although minted for seventeen years, they have become exceedingly rare, most of them having long since been melted down for their value as metal. Platinum appears to have been first introduced into Europe from South America about the middle of the eighteenth century under the name *Platina* (the diminutive of *plata*, the Spanish for "silver") *del Pinto*, and the first scientific description was published by an English physicist, Sir William Watson, who made the discovery that it was a new metal. Although first found in Colombia, then known as New Grenada, practically the whole of the world's supply has come from the Urals, the principal districts being Nizhne Tagilsk and Goroblagodatsk, where it is found in shallow drifts with pebbles of serpentine, which represent the original matrix. The working of the mines has been seriously interrupted by the war, and still more by the disintegration of society following on the revolution in Russia. Consequently the discovery of platinum in workable quantities elsewhere is much to be desired, so important and necessary is this metal for many industrial and scientific operations. Although so rare, it appears to be widely, if sparsely, distributed, occurrences having been reported in British Columbia, Alaska, Oregon, and California, in Borneo, New South Wales, and New Zealand, and even in County Wicklow.

Dr. Kunz describes some curious happenings at Quibdo, the capital of the Choco district in Colombia, in consequence of the great rise in the price of platinum. This metal was originally separated as waste in the refining of gold by the dry, or "blower," system, and thrown into the street. Later, when platinum became even more valuable than gold, the entire town of some 1500 inhabitants was turned into a mine, natives working the streets for the Government, and many property-owners mining under their houses. It is said that one man pulled his store down and recovered enough platinum to build a larger one, and yet net a balance of about 800*l*.

The total world's supply of platinum appears to be about 120 metric tons. Its principal purposes are in catalysing processes, for chemical, physical, and electrical apparatus, and for use in dentistry and jewelry.

THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

IT has been our privilege during the four years of war to publish many articles upon scientific aspects of industrial developments in various directions. When supplies from enemy countries were cut off, it was necessary to establish here the manufacture of products and instruments for which we had previously been dependent almost entirely upon Germany. The sudden stoppage of the supply of optical glass required for the manufacture of sighting telescopes for guns, field-glasses, range-finders, and other service instruments was for a time the cause of national anxiety, but the situation was saved by the work of the Institute of Chemistry and Sir Herbert Jackson, which enabled manufacturers to produce the glasses required, not only for optical instruments, but also for laboratory purposes. The pure potash required for certain glasses is obtained by an electrolytic process, and we need never again go to Germany for it or for the glass itself.

We are meeting all demands for such synthetic organic drugs as salicylic acid and aspirin, phenacetin, salvarsan, and many others, photographic chemicals, synthetic dyes and associated products, as well as hundreds of similar substances of which Germany had the monopoly. The magneto industry has established itself in a sound position, and the German instrument has been displaced for good. Hard porcelain for electrical fittings and laboratory ware is now British-made, thanks to scientific work and industrial enterprise. We produce all the tungsten required for special steels and metallic filament lamps, and can supply the world if necessary; we make aluminium alloys superior to any of the German pre-war products, and like success has been attained in other directions.

While our military, naval, and air services have been actively engaged in battle, the allied forces of science and industry have been making advances no less noteworthy, though their conquests do not occupy much public attention. What has been achieved in scientific industry during the last four years is most creditable both to scientific workers and to manufacturers, and we are glad that steps have been taken to enlighten the public upon this matter by the organisation of a British Scientific Products Exhibition, which will be opened on August 12 at King's College, London.

The British Science Guild, with the assent of the Ministry of Munitions and the approval of the Board of Trade, has arranged for this exhibition to be held for four weeks during August and September. The exhibition will include products and appliances of scientific and industrial interest which prior to the war were obtained chiefly from enemy countries, but are now produced in the United Kingdom. The chief purpose of the exhibition is to make clear the necessity of scientific research with respect to the application of its results in the arts and industries; and, further, to display to the public and to those intimately concerned how much has been successfully achieved in this regard since the advent of the war in the production of articles of prime importance, not only for the home, but also for foreign markets, hitherto manufactured in or imported from other countries.

Such an exhibition at the present time will have a most stimulating influence upon scientific and industrial research and upon manufactures, and the highest permanent interests of the nation will be promoted thereby. His Majesty the King has shown his interest in the exhibition by becoming the Patron; while the Marquess of Crewe is president, and the vice-presidents include the Prime Minister and other leading members of the Government as well as distinguished representatives of scientific, educational, and industrial institutions. More than 250 manufacturers are sending exhibits; and the Air Ministry is arranging a large display of its scientific activities, as well as the Food Production Department. It is understood, of course, that some manufacturers—for example, opticians and scientific instrument makers—are unable to send exhibits on account of their reduced staffs and the insistent demands made for immediate delivery of all instruments or appliances produced by them; nevertheless, there is no doubt that the exhibition will afford an impressive object-lesson of British scientific activity and industrial enterprise.

The manufacturers who are participating in the exhibition are doing so largely from patriotic motives, as no goods will be sold, and any advantage they may derive from their display will be indirect. What is desired chiefly is to educate the public to know that British science and British industry can, when conditions are favourable, excel in manufactures which were popularly supposed to be essentially German. We have recovered lost ground, and we need never lose it again if the development of industry through science is made a national aim.

It might have been supposed that the Department of Scientific and Industrial Research would have been able to afford financial aid to such an exhibition as that shortly to be opened, but we understand that neither it nor any other Government Department has yet contributed a grant towards the heavy expenses involved. The whole cost will have to be met by voluntary contributions, and it is to be hoped that the patriotic efforts of the British Science Guild to give confidence in our scientific strength and encouragement to its industrial application will receive generous support from all who are in the position to give it. Donations should be sent to the Treasurer, British Scientific Products Exhibition, British Science Guild, 199 Piccadilly, London, W. 1.

NOTES.

ATTENTION has been directed several times in these columns to the progress of the dyes industry in this country, and last week a brief statement was given of the proposals of the Government in the direction of giving further assistance to the firms engaged in the manufacture. The Supplementary Estimate referred to was discussed in the House of Commons on Thursday, July 25. Some opposition was raised to the scheme mainly on the ground that there was a lack of information before the House as to what had been done with the money already advanced, and how the present proposed grant of 600,000*l.* towards extensions and plant was going to be utilised. It would undoubtedly be interesting to have a clear statement as to the disposal of the funds already allocated to "British Dyes, Limited," but most of the speakers on Thursday last failed to appreciate the fact that the dyes industry is not only of the first importance to the country, but also a manufacture of a peculiar character, dependent as it is on the constant association of research in the laboratory with processes in the works. The amount of capital invested in the manufacture in Germany may be roughly estimated at about ten times that which is at the disposal of firms in this country, and during the first few years they will require all the encouragement and assistance of every kind—financial and protective—which can be afforded.

THE progress made in this country in the production of laboratory requirements formerly imported has been referred to frequently in these columns. We learn that arrangements have been made at the National Physical Laboratory for the testing of scientific glassware and porcelain and of filter-paper. For the present, while the organisation is in course of development, firms sending vessels for examination will be required to give notice (on forms provided for the purpose) of their wish to have apparatus examined not less than a week before dispatching the goods. The tests will include volumetric tests of graduated vessels and tests on the resistance of vessels to chemical action and their suitability for use in chemical operations. In the latter case the tests to be applied have been discussed with the Glass Research Committee of the Institute of Chemistry. With regard to the volumetric accuracy of glassware the tests will be divided into (1) vessels of the highest scientific accuracy, and (2) vessels intended to possess only commercial accuracy. It is intended that those in the first category shall be examined at Teddington, and that those in the second shall eventually be tested locally when centres for the work have been established. Information with regard to the scheme is obtainable from the director.

WE regret to announce the death on July 28, in his seventy-ninth year, of Dr. F. T. Roberts, University College, London and author of a "Handbook of the Theory and Practice of Medicine" and many professional papers, as well as of articles in Quain's "Dictionary of Medicine," of which he was formerly the assistant editor.

MR. FRANK N. MEYER, a botanical expert on the staff of the American Department of Agriculture, was recently found drowned in the Yangtse River. For nearly ten years he had travelled as an explorer through China, Turkestan, and Siberia, and had introduced into the United States hundreds of species and varieties of Eastern plants.

THE death is announced, in his eightieth year, of Dr. George M. Searle, of Washington, D.C. Dr. Searle graduated at Harvard in 1857, and shortly afterwards entered the service of the U.S. Coast Survey. He next became assistant professor of mathematics in the U.S. Naval Academy. In later life he devoted himself especially to astronomy. He established the observatory in the Catholic University at Washington, where for several years he held the chair of mathematics.

WE regret to note that the *Engineer* for July 26 records the death on July 18 of Mr. Edmund Herbert Stevenson. Mr. Stevenson, who was sixty-five years of age, was responsible for the design and execution of many gas, water, and drainage works, and was joint author of books dealing with legislation affecting gas and water undertakings and with the water supply of the metropolis. He was a well-known expert witness, and a member of the Institution of Civil Engineers.

THE death occurred on July 26, in his sixty-fourth year, of Mr. Henry R. Knipe, who produced a sumptuous volume about twelve years ago entitled "Nebula to Man." The work was an attempt to sketch in rhyme the evolution of the earth on the nebular hypothesis, the subsequent sea and land movements, and successive appearances of life, as revealed by the geological strata. It was embellished by a remarkable series of illustrations of prehistoric scenes and creatures, fourteen reproduced in colour and seventy-seven by the half-tone process, and all of them by artists distinguished for their skill in portraying such subjects.

WE have just learned that Prof. Vladimir Amalitsky, of Warsaw, died suddenly at Kislovodsk, in the Caucasus, on December 28, 1917. Born in Volhynia in 1860, Prof. Amalitsky completed his education at the University of Petrograd, where he made a special study of geology under Prof. Inostransev. Early in his career he was appointed professor of geology and palæontology in the University of Warsaw, and he eventually became director of the Polytechnic Institute in the same city. With the aid of his accomplished wife, he devoted himself to the study of the Permian rocks of Russia, and will always be remembered by his discovery of the great deposits of fossil reptiles in the cliffs of the northern Dvina. During 1899 and 1900 he excavated from these deposits numerous skeletons of Pariasaurus, Dicynodonts, and Theriodonts, closely resembling those from the Karoo formation of South Africa; and with them he found abundant remains of the typical Glossopteris flora. For several years Prof. Amalitsky superintended the preparation of the fossil skeletons in the museum of the University of Warsaw, but, unfortunately, they still remain undescribed. With Mme. Amalitsky he paid repeated visits to the British Museum, where he spent many months in special studies, but his only detailed publications were on the Permian fresh-water bivalved shells. These small fossils, however, proved to be of exceptional interest, and in a paper read before the Geological Society of London in 1895 Prof. Amalitsky showed the close correspondence between the Permian species of Russia and the Karoo species of South Africa. Just before the outbreak of war he had arranged for one of his students to visit the British Museum to prepare himself for monographing the Russian Permian reptiles, but in the circumstances the work had to be postponed.

DR. A. D. BEVAN in his presidential address to the American Medical Association (see *Science*, June 21, p. 597) gives a good account of the organisation of the American medical profession for purposes of war. Surg.-Gen. Gorgas, who did such splendid work in Panama, is the chief of the American Army Medical Service, and he has enlisted to help him those who in civil life are recognised leaders in their special fields of work—men like Profs. Welch and Vaughan, Dr. de Schweinitz, and scores of others. There are in the United States more than 145,000 men and women practitioners, so that there is ample *personnel* to draw from. For an army in the field 10 per cent. of its numbers will be in the medical department. Thus for an army of 3,000,000 some 300,000 officers and men are required for medical and sanitary work, of whom 25,000 will be qualified physicians and surgeons. Already 25,000 medical practitioners have gone into the medical departments of the American Army and Navy, and it is proposed to raise the number to 30,000 this year.

PROF. HENRY LOUIS stated in his presidential address to the Society of Chemical Industry, at the recent meeting in Bristol, that the chemical industry in this country has been in some respects practically stationary during late years, and that this fact is most noticeable in the failure to take advantage of modern mechanical methods of handling large bodies of material; that, in other words, not sufficient has been made of the application of modern engineering methods to the chemical industries. As he points out, the difficulty lies in finding men who are equally conversant with the chemical problems to be solved and the engineering facilities available for their solution. A man with an adequate training both in chemistry and engineering is required. Such a man, and no other, has the right to call himself a chemical engineer. These men do exist in this country to-day, notably Sir George Beilby and Sir Dugald Clerk, but there are very few of them, and undoubtedly one of the most pressing problems which will have to be solved is the securing of an adequate supply of chemical engineers to maintain and develop the great industries of the country. Prof. Louis—who, by virtue of his position and his work, is associated more with the mining and metallurgical than with the chemical industries—devoted his address mainly to a consideration of the nature of the principal problems that a chemical engineer is called upon to conduct, and illustrated it by reference to a process which, though metallurgical in name, is chemical engineering in fact, namely, the hydrometallurgical extraction of gold by the cyanide process. The magnitude of this industry may be gauged from the fact that the Witwatersrand alone cyanides more than two and a quarter million tons of ore per month. This process has developed slowly from quite modest beginnings a quarter of a century ago. It has now reached a very high pitch of perfection.

THE report of the council of the Association of British Chemical Manufacturers was presented at the second annual general meeting of the association, held on July 11. Dr. C. Carpenter, who was in the chair, referred to several matters of public interest in the course of his remarks in moving the adoption of the report. Progress has been made with the Directory, the bulk of which is now in the printers' hands. The Directory will be printed in English, French, Italian, Spanish, Portuguese, Russian, and Japanese, and will thus provide for a very comprehensive circulation throughout the markets of the world of information relating to British manufacture in connection with chemical products. A very useful system has been put into operation for placing at the disposal of members of the association a good deal of information available at the Department of Overseas Trade and the Foreign Office. In dealing with the question of industrial alcohol the association has been very helpful. When it is remembered how long it has taken to educate the Government on the technical questions connected with the use of alcohol in chemical manufacture, it will be realised that a great advance has been made in the acceptance of the recommendations of the alcohol committee of the association. An information and statistical bureau has been established with the view of avoiding overlapping and waste of time and energy in research and manufacture. The council has supported the efforts of the Chemical Society in establishing a comprehensive library of chemical technology. With regard to the difficult problem of the dyes industry, Dr. Carpenter thinks that the course followed in 1915 in developing the explosive manufactures of the country, viz. to use all and everybody, great and small, in order to get all working in the direction of making up the shortage, is the right one; and that the concentration of the work in the hands of only a few firms, as appears to be the present policy in dealing with the dye situation, will not produce such a measure of national success as if all the resources of the country are utilised. Lord Moulton has accepted the position of president of the association. Mr. R. G. Perry, C.B.E., has been elected chairman, in succession to Dr. C. Carpenter, and the Rt. Hon. J. W. Wilson has been elected vice-chairman.

IT was recommended by the Imperial War Conference held in London last summer:—"That it is desirable to establish in London an Imperial Mineral Resources Bureau, upon which should be represented Great Britain, the Dominions, India, and other parts of the Empire." The importance of the matter has been urged on several occasions in the columns of NATURE (see, for example, the issues for October 5, 1916, and September 13, 1917). By direction of the War Cabinet, the Minister of Munitions, in May, 1917, appointed an Inter-Departmental Committee to prepared a scheme for the establishment of the proposed Bureau. After consideration of the report of this Committee the Government instructed the Minister of Reconstruction, in consultation with the Secretaries of State for the Colonies and India, to give effect to the recommendations of the Imperial Conference and the findings of the Committee. It is now announced that the Bureau will be incorporated by Royal charter, and the governing body, which will be under the presidency of the Lord President of the Council, will consist of the following:—Chairman, Sir Richard Redmayne, K.C.B.; nominated by the Canadian Government, Dr. W. G. Miller; Commonwealth of Australia, Mr. W. S. Robins; New Zealand, Mr. T. H. Hamer, of the High Commissioner's Office; Union of South Africa, the Rt. Hon. W. P. Schreiner, C.M.G.; Newfoundland, the Rt. Hon. Lord Morris, K.C.M.G.; India, Mr. R. D. Oldham, F.R.S.; nominated by the Secretary for the Colonies, Dr. J. W. Evans; nominated by the Minister of Reconstruction (in consultation with the Institution of Mining and Metallurgy, the Institute of Metals, the Iron and Steel Institute, and the Institution of Mining Engineers), Mr. W. Forster Brown (Mineral Adviser to H.M. Woods and Forests), Prof. H. C. H. Carpenter (president of the Institute of Metals), Dr. F. H. Hatch (member of the Mineral Resources Advisory Committee of the Imperial Institute), Sir Lionel Phillips (lately Director of the Mineral Resources Development Department, Ministry of Munitions), Mr. Edgar Taylor (ex-president of the Institution of Mining and Metallurgy), and Mr. Wallace Thorneycroft (president of the Institution of Mining Engineers). Mr. Arnold D. McNair has been appointed secretary. All communications regarding the Bureau should be addressed to the Secretary, Imperial Mineral Resources Bureau, Holborn Viaduct Hotel, E.C.1.

AMONG the recent additions to the Municipal Museums, Hull, we notice the collection of birds' eggs, land, fresh-water, and marine shells, all from Lincolnshire, formed by the late John Beaulah, of Ravensthorpe; also two very large narwhal tusks, and an excellent model of the railway engine *Victoria* and tender, dated 1859, which was shown at the Great Exhibition in 1861, bequeathed by the late H. Astropp.

MR. A. J. LOSEBY, the veteran Registrar of the Market Bosworth County Court, has sent us a copy of his work entitled "The Great Hereafter and the Road to Perfection" (London: A. H. Stockwell, price 1s.). Though the subject lies outside the usual range of this journal, we cannot help remarking on the manner in which the elemental aspirations of humanity are dealt with in these blank-verse narratives, which maintain a high level by their dignified simplicity. The story of the triumph of motherhood in the midst of horrors that creep upon a flaming world is Dantesque without being imitative.

THE Museum Journal of the University of Pennsylvania (vol. viii., No. 4, December, 1917) is devoted to an account by Mr. C. S. Fisher of the work done by the Egyptian expedition at Memphis financed by

Mr. Eckley B. Coxe, jun. Portions of the palace of Meremptah have been excavated with important results. On the daïs where the king's throne stood were found four large panels, each containing a bound captive—a negro, a Libyan, a Sardinian, and a fourth not yet identified. In the stratum assigned to Ahmose II. there was found a cache of gold and silver jewelry. At Dendereh was discovered a necklace composed of selected amethysts and carnelians, the large beads bearing the name of Sesostris I. (B.C. 1980–35) inscribed upon them.

IN *Folklore* (vol. xxix., No. 1) Mrs. M. A. Holland, in a paper entitled "The Influence of Burial Customs on the Belief in a Future State," examines Sir James Frazer's well-known paper, "On Certain Burial Customs as Illustrating the Primitive Theory of the Soul" (Journal of the Anthropological Institute, 1885). The author examines this theory from the pre-animistic point of view, and discusses certain customs associated with burial and the modes adopted by early man for the disposal of the corpse. As an illustration of the method of inquiry, she inquires why, according to Plutarch, an exile, reported to be dead, for whom funeral ceremonies have been performed, may not re-enter his house through the door, but must find a way through the roof. The hitherto accepted explanation is that he is still officially dead, must be considered a ghost, and as such it is physically impossible for him to cross the threshold, which has been rendered ghost-proof by a mystic barrier of fire and water. But the more primitive motive may have been that he was regarded as uncanny because, officially speaking, he had been once dead, and so must not be given the chance of contaminating a holy place like the threshold. The paper gives a good *résumé* of the more recent views on animism, and deserves study.

SINCE the house-fly has been clearly recognised as a great danger to the health of the community much attention has been paid to a study of its habits, and particularly to the conditions which are favourable for breeding. One aspect of the subject—the over-wintering of the house-fly—is dealt with in an article by Mr. R. H. Hutchison in the *Journal of Agricultural Research* (vol. xiii., No. 3). The conclusion of the author, after about three years' experimental work on the subject, is that there is no evidence to show that house-flies persist as adults in houses or stables from November to April, for a temperature lower than 32° F. is fatal if continued for any length of time. On the other hand, if flies find access in the autumn to buildings such as restaurants, where insufficient attention is given to the disposal of kitchen waste, they will continue breeding throughout the winter. In such cases the flies present in March or April, which are the offspring and not the survivors of those which found their way into such places in the preceding autumn, will escape on warm days and produce the hordes which appear late in May. From experiments with larvæ and pupæ, and from the fact that house-flies do not appear in large number until late in May, the author concludes that only a small percentage of the larvæ present in manure-heaps in the autumn live through the winter to give rise to adults in the spring. These conclusions emphasise once more that the proper disposal of kitchen waste is the only effectual method of attacking the house-fly.

MR. R. S. LULL (*Amer. Journ. Sci.*, vol. xlv., p. 337, 1918) describes under the new name Laoporus a number of quadrupedal tracks from Carboniferous strata in the Grand Cañon of the Colorado River. In referring some smaller impressions to Exocampe, a genus known in the Trias of Connecticut, the author remarks that these tracks are surely not reptilian, nor are they proved to be amphibian. He places them in Williston's Protopoda, a group so far known only by its footprints.

THE subject of the deposition of flint is further pursued by Mr. R. S. Dean in reference to the Missouri cherts (*Amer. Journ. Sci.*, vol. xlv., p. 411, 1918). It is urged that the association of carbon dioxide with the silica hydrosol in the presence of calcium carbonate leads to the formation of an acid carbonate that becomes readily dissociated. Calcium ions thus arise and precipitate colloidal silica, with greater effect than the hydrogen ions of less valency that are formed from the dissociation of carbonic acid. Experiment shows that without carbon dioxide a colloidal silica solution may remain stable in the presence of ground calcite for more than a year, while the presence of carbon dioxide promotes precipitation in an hour. In Mr. Dean's experiments actual silicification of the calcite did not occur, but in this matter the author regards time as an important factor.

THE Agricultural Statistics of India (vol. i.) for 1915–16 were published early this year by the Government Printing Office, Calcutta. Considerable progress has been made since 1906–7; the total number of bovine livestock has increased by 60 per cent., and is now 149 millions; the totals for "cultivable area" and "net area cropped" show a steady increase. The areas devoted to cotton and jute suffered a decline (exceeding 25 per cent.) from the previous year, probably caused by a fall in price due to the war. On the other hand, the area under indigo (chiefly in Madras Province) was more than doubled. It is reported that the official trials of the yield of the various crops indicate a general increase in the yield per acre since 1911–12; in the case of sugar-cane in Bengal the increase exceeded 16 per cent. The increased cotton yield in Sind (more than 20 per cent.) is ascribed to the use of Egyptian cotton-seed.

IRON, though a common component of thermo-couples, has the disadvantage of oxidising rapidly when exposed to temperatures beyond 500° C. It would be possible (according to O. L. Kowalke, in American Electro-chemical Society Proceedings, October, 1917) greatly to extend the use of iron in thermo-couples if a method could be devised of protecting it from oxidisation by a covering which would not appreciably affect the e.m.f. This result is achieved by "calorising" the iron, *i.e.* forming on its surface a coating of a rich alloy of aluminium. Iron so treated can be exposed to temperatures as high as 1000° C. without oxidising. Tests show that calorised iron when used with constantan gives the same thermo-e.m.f. as ordinary iron, and has a longer life.

IN the *Cairo Scientific Journal* (vol. ix., No. 101, 1917) is a paper by the late Sir Armand Ruffer on the use of natron and salt by the ancient Egyptians. Natron is a natural soda deposit consisting of impure sodium carbonate and bicarbonate, and the question of its use for the embalming of mummies by immersion in a natron bath, as indicated by Herodotus, has been investigated by chemical and microscopical methods. In the result it is agreed that salt and natron were used by embalmers, but no evidence was found that the bodies were placed in a natron bath or a salt bath. It is not intended to deny that the accounts given by Herodotus are correct; indeed, they are corroborated in some of the other details, and bear the stamp of truth, but it appears certain that no bodies prepared by the method Herodotus describes have been found so far.

ACCORDING to the *Scientific American* for June 22, the American Government has received thousands of suggestions for the protection of sea-going vessels from attack by submarine. Often the same suggestion is made by many different inventors, the great majority of whom show a lamentable ignorance of the conditions which prevail at sea. Seven devices are illustrated, four of which consist of padding for the hull, which would either increase the resistance of the ship and diminish its speed greatly, or would be carried away by the first heavy sea. Another device deflects the torpedo below the keel, the inventor not appearing to know that it would be fired by the deflection. The other devices are for preventing the sinking of the vessel after she has been struck, and involve either an inner hull or a series of air-bags which can be pumped up and pulled under the side of the vessel struck. Would-be inventors of devices for this purpose might save themselves and the Government Departments much trouble by consulting this article.

ATTENTION may be directed to a very useful article by Dr. P. E. Spielmann in the *Chemical Trade Journal* for July 6 and the three previous issues, giving a summary description of the constituents of coal-tar and their properties. A large number of substances has been found in coal-tar—from three hundred to four hundred, of which about one hundred and fifty have been determined quantitatively and ninety definitely isolated. On a large scale only four are separated as the pure individual substances, namely, benzene, toluene, naphthalene, and phenol, though others, such as xylenes, cresols, and the hydrocarbons of solvent naphtha, are used in considerable quantities in the form of mixtures of their homologues. The article, which is based upon a German account with additions and modifications, is designed to give a general survey of the lesser-known as well as the more valuable substances obtainable. By reason of the exploitation of the coal-tar industry in Germany the minute examination of the constituents of tar has so far been due largely to German chemists. The results obtained are of great value, and it is hoped that detailed and difficult work of this kind will in the immediate future be carried on in this country, since our chemists are fully capable of doing it. In any case, the information collected will prove serviceable.

THE first of a series of articles on time studies for rate setting on machine tools appears in *Industrial Management (The Engineering Magazine)* for June. The author, Mr. Dwight V. Merrick, has had exceptional opportunities of studying this important subject. Some nineteen years ago he became associated with Dr. Taylor, and for the last fifteen years has specialised on the taking of time studies and the setting of tasks and rates. He also possesses the faculty of setting down in clear, concise style the knowledge he has gained during lengthy investigations, and his articles can be recommended confidently to any who wish to become further acquainted or to make personal experiments with Dr. Taylor's efficiency methods. Full instructions are given for the practical carrying out of time studies and for the analysis of the results. The matters dealt with include:—(*a*) Study of the work and conditions that influence its performance; (*b*) analysis of the work into its elements; (*c*) observing and recording the elapsed time for the performance of each of the elements; (*d*) study and analysis of the records obtained in (*c*); (*e*) determining a just time for the performance of each of the elements; (*f*) preparing from the time-study records an instruction card, including the determining of an allowance for fatigue and unavoidable delays. The first article includes formulæ and a set of interesting graphs giving the "variation allowance," *i.e.* the additions that must be made to the actual sum of the unit times in order to take care of the factors that slow down work. Fatigue is one of the major factors, and its influence is relatively diminished as the percentage of handling time is lessened for the complete cycle of operations. Those interested will find a great deal of valuable practical information in these articles.

SIR WILLIAM RAMSAY before his death had compiled a biography of Dr. Joseph Black, whose fundamental experiments on chemical combination and on heat made a lasting impression on science. This volume, with an introduction by Prof. F. G. Donnan on Sir William Ramsay himself, illustrated by sundry reproductions and portraits, is now in the press, and will be published by Messrs. Constable. Besides an account of Dr. Black's life and work, there are some of his letters and descriptions of academic life in Glasgow and Edinburgh of the eighteenth century.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, W.C.2, have shown enterprise in issuing a catalogue, called by them a "War Economy" catalogue, of books relating to botany likely to be of especial interest and service at the present time. It contains some 2000 items, arranged conveniently under the headings of Agriculture, Husbandry, and Gardening (general subjects), Cereals and Bread, the Flower Garden, Forestry, Timber, etc., Fruit and Fruit Trees, Grape Vine, etc., Grasses and Forage Plants, Herbals, Hybridity, Heredity, etc., Orchids, Vegetable Gardening, Economic Botany, and Medical Botany. It will doubtless appeal to many readers of NATURE. Copies are obtainable from Messrs. Wheldon for the sum of twopence.

OUR ASTRONOMICAL COLUMN.

THE NEW STAR IN AQUILA.—The decline of the new star appears to be proceeding very slowly, the brightness on July 27 being still about equal to that of the neighbouring 4th magnitude star θ Serpentis. The visual spectrum, as observed by Prof. Fowler, has shown but little change during the past fortnight. The bright lines of hydrogen and the band λ 464 were very conspicuous throughout this period when observations were possible, and the green line about λ 501, which is possibly identical with the chief nebular line, was of nearly the same brightness as H_β. Three fainter lines in the yellow, about $\lambda\lambda$ 588, 576, and 568, also remained visible.

THE GENERAL MAGNETIC FIELD OF THE SUN.—The results of a further investigation of the Zeeman effects due to the general magnetic field of the sun have been given by Messrs. Hale, Seares, Van Maanen, and Ellerman (*Astrophys. Journ.*, vol. xlvii., pp. 206–54). The photographs were taken in the third order of the 75-ft. grating spectrograph in connection with the 150-ft. tower telescope at Mount Wilson. With the aid of suitable polarising apparatus the observations are reduced to the measurement of line displacements, but these are so minute, and the lines so wide in comparison with their shifts, that definite evidence of the reality of the displacements has been established only after very great labour. It is satisfactory to find, however, that the twenty-six additional lines which have been observed to give measurable displacements confirm the earlier results, and seem to place beyond reasonable doubt the conclusion that the sun behaves approximately as a uniformly magnetised sphere, with a polarity corresponding with that of the earth. The deduced values of the field-strength in Gaussian units at the sun's magnetic pole range from 9·9 to 54·7, but it is shown that, in general, the values corresponding with a given line-intensity are approximately equal. For iron and chromium, at least, there is a rapid decrease in field-strength with increasing line-intensity, and, in view of Mr. St. John's conclusion that lines of increasing intensity represent successively higher levels in the solar atmosphere, it would appear that the strength of the sun's general field falls off rapidly with increasing elevation above the surface. The part of the field at present accessible to observation lies within the bounding surfaces of a thin shell in the solar atmosphere about 150 km. in thickness. The anomalous behaviour of certain lines which fail to show displacements has not yet been completely explained, but the lines in question may possibly originate outside the effective field.

THE SPECTROSCOPIC BINARY BOSS 1082.—This star, of magnitude 5·3 and type G5, was found to have a variable velocity by the observers at Mount Wilson. The orbit has now been computed by Mr. J. B. Cannon from forty-two photographs of the spectrum taken at the Dominion Observatory, Ottawa, during the years 1916, 1917, and 1918 (Journ. R.A.S. Canada, vol. xii., p. 210). The elements of the orbit, with their probable errors, are as follows:—

$P = 121$ days
$K = 28{\cdot}19$ km. $\pm 1{\cdot}2$ km.
$e = 0{\cdot}019$ $\pm 0{\cdot}042$
$\omega = 285^\circ$ $\pm 42{\cdot}68^\circ$
$\gamma = -40{\cdot}47$ km. $\pm 0{\cdot}81$ km.
$T = $ J.D. $2{,}421{,}137{\cdot}55 \pm 14{\cdot}26$ days
$a \sin i = 46{,}900{,}000$ km.

$$\frac{m_1^3 \sin^3 i}{(m_1+m)^2} = 0{\cdot}28 \times \text{sun}$$

MARINE BIOLOGY IN THE UNITED STATES.

UNDER the direction of Dr. A. G. Mayer, the Department of Marine Biology of the Carnegie Institution of Washington continues to carry out researches of great value, and vol. xii. of the Papers from the department, issued March, 1918, fully maintains the high standard of previous volumes. From the point of view of general interest, perhaps the most striking paper is Mr. E. W. Gudger's account of the habits of the gaff-topsail catfish (*Felichthys felis*), a large catfish which is found at Beaufort, North Carolina. In this species the ova, which are very large, being as much as 1 in. in diameter, are carried in the mouth of the male parent until the larvæ are hatched, and the young are retained in this situation for some considerable time until the yolk-sac has been absorbed. The largest number of eggs found in the mouth of any one male was fifty-five, and numbers above twenty were quite frequent. The habit of oral gestation in catfishes of various species and from many different geographical regions has, of course, long been known, but the carefully ascertained details recorded in the present paper will be much appreciated by field naturalists.

Mr. Gudger also contributes a memoir on the Barracuda (*Sphyraena barracuda*), a well-known West Indian fish of fierce and voracious habits, which is much used as a food-fish. In the course of this memoir considerable space is devoted to a discussion of the occasionally poisonous character of this fish. As is well known to West Indian residents, although the flesh is generally a perfectly wholesome article of diet, occasional specimens are met with which when eaten cause serious illness, with symptoms which are considered distinct from those of ptomaine poisoning. Although the author has been at some pains to collect all the literature dealing with this poisoning, he has failed to find any modern scientific account by a medical writer, and it would appear to be a matter which calls for a thorough investigation by those interested in tropical disease. The fact of the occurrence of these cases has been quite familiar to medical practitioners in the West Indies for many years, but, judging from the information in the present memoir, little progress has been made in discovering the cause of the trouble.

Another paper dealing with fishes is one by Mr. C. F. Silvester on fishes new to the fauna of Porto Rico. As a result of a three weeks' visit to the island the author obtained eight species which he regards as new to science, and the present communication is devoted largely to a detailed description of these, illustrated by excellently coloured figures.

Miss E. G. White deals with the origin of the electric organs in *Astroscopus guttatus*, and gives a valuable survey, with a very complete bibliography, of the whole question of the electric organs of fishes, which should be very useful to anyone seeking information on this subject.

Dr. Mayer himself contributes two short papers of considerable importance. The first describes a series of experiments on toxic effects due to high temperature, in which a number of reef-corals were kept in warm ocean-water for sixty minutes in the dark, and the temperature was found which was just sufficient to kill the coral. The author concludes that "it seems possible that death from high temperature may be due to the accumulation of acid (possibly H_2CO_3) in the tissues, the rate of formation of this acid being related to the rate of metabolism of the tissues. Thus animals of the same class having a high rate of metabolism, as measured by oxygen consumption, are more sensitive to heat and to CO_2 than those having a low rate of metabolism." Dr. Mayer's second paper is a short note, in continuation of previous work, on nerve-conduction in diluted and in concentrated sea-water, the Scyphomedusa (*Cassiopea xamachana*) being the animal used in the experiments, and the salinities employed ranging from 18·13 to 60·96 per thousand.

Mr. J. F. McClendon writes an important paper on "Changes in the Sea and their Relation to Organisms." Adopting the most refined modern methods of analysis, he has studied a number of physical and chemical problems which have a direct bearing on the life of the plants and animals of the sea. Amongst the problems dealt with are ocean currents, oxygen tension in sea-water, and the chemical precipitation of calcium carbonate in sea-water, his observations on the last-named being particularly suggestive.

Mention must also be made of Mr. S. C. Ball's observations on the migration of insects to the Rebecca Shoal light-station, an isolated station 105 miles from the mainland of Florida and 95 miles from the coast of Cuba. Mosquitoes and house-flies are the insects chiefly discussed, and some striking figures are given which have an important bearing on the problem of insect migration. Other papers are on amphibians and reptiles from Porto Rico and the Virgin Islands by H. W. Fowler, and on the botanical ecology of the dry Tortugas by H. H. M. Bowman. Dr. Mayer is to be congratulated upon a most interesting and important volume.

E. J. A.

GYPSUM IN SOUTH AUSTRALIA.

SOUTH AUSTRALIA possesses extensive deposits of gypsum, and the technical importance of this mineral, when of a sufficient degree of purity, has led the State Department of Chemistry to undertake an investigation of the deposits and of their possible applications. The results of the inquiry are contained in Bulletin No. 7 of the Department, the author of which is Mr. D. C. Winterbottom. The bulletin has been extended to form a monograph on the subject of gypsum, although it is admitted that, owing to the difficulty of procuring the original journals in Adelaide, the references to previous work are incomplete. Nevertheless, much interesting information has been collected and brought into a convenient form, so that the publication has considerable value, apart from the special descriptions of local conditions.

The most important deposits occur in the neighbourhood of Marion Bay and Cape Spencer, in the hundred of Warrenben, at the south end of Yorke Peninsula. These are gypsum lakes, dry in summer but covered with water in winter, the mineral forming a compact layer of translucent crystals, resting on a floor of hard limestone. The layer varies from 6 in. to 4 ft. thick, but in one of the lakes a thickness of 8 ft. is attained, although the greater part of this, being below water-level, has not yet been worked. The water of the lakes being a strong brine, the mineral as quarried contains salt, most of which washes out when the broken mass is exposed to the weather in the stock pile for a few months. In addition to these massive deposits, sandhills occur at Lake Fowler, in the hundred of Melville, Yorke Peninsula, which are entirely composed of flour and seed gypsum, some of the quarry faces being from 60 ft. to 80 ft. in height, whilst the mineral extends below the present floor-level. Flour and seed gypsum are widely distributed throughout the State, largely in the arid regions, but these deposits have been little worked owing to the difficulties of transport.

The workings in the hundred of Warrenben are already fairly extensive, and modern methods of quarrying, blasting, loading, and shipping are employed. Whilst the inferior qualities, including those which occur in the form of flour and seed, may be used as fertilisers, only the purer mineral has been converted into plaster of Paris, this being its most important technical application. Attempts had been made to manufacture plaster in Australia for many years, but without much success, and until recently the Australian requirements have been supplied by importation from Germany and the United States. Several companies have been formed since the outbreak of the war and are successfully producing plaster. There are now two plaster mills in South Australia, two in Victoria, and one in New South Wales, all using South Australian gypsum. Both the rotary calciner and the kettle process are in use, and a preliminary washing of the crushed rock is necessary in order to remove soluble impurities and fine, slimy calcium carbonate. Organic matter is always present, and greatly influences the quality of the product, since a pure white plaster is desired for most purposes, and the whiteness is readily destroyed by even slight charring of organic impurities. Such charring is most serious in the kettle process, as in this case the material is not reground after calcination; whilst plaster made in a rotary calciner, although darker at first through local overburning, loses its colour in the subsequent regrinding. On the other hand, overburning is more easily avoided in the kettle process, and it appears to yield a product with a more uniform rate of setting. Tables are given in which a large number of Australian and imported plasters are compared in regard to setting-time, colour, mechanical strength, and other properties, the chemical analyses being also included. Experiments in the preparation of plaster from seed and flour gypsum are described, and recommendations as to the precautions to be taken to ensure a good and uniform product are made. Given sufficient care in manufacture, the Australian deposits are quite capable of yielding plaster of the highest quality. Charred organic matter and hygroscopic salts are the most deleterious impurities.

In view of the absence of deposits of sulphur or of high-grade pyrites from South Australia, the possibility of using gypsum as a source of sulphuric acid is discussed. Many processes have been patented, but none has so far emerged from the experimental stage, although the preparation is quite feasible, and may, in the face of the necessity for obtaining sulphuric acid from local sources, prove to be of some importance.

THE CLAIMS OF GERMAN IRONMASTERS.

SIR ROBERT HADFIELD has done the nation excellent service by issuing a translation of the report of the general meeting of the Association of German Ironmasters held in April last. The report gives an account of the discussions at the meeting and of the speeches made at the dinner which followed it; there appear to have been only two papers submitted, namely, "The Share Borne by the German Ore-bearing Beds in the Maintenance of the Home Iron and Steel Industries" and "The Reserves of Coal in Germany as Compared with the World's Reserves"; these are given in the report only in brief abstract, but their tendency can be well gathered from the discussion upon them. The whole of the second paper may probably be looked upon as summarised in the one sentence, "Germany in any case is the coming country in Europe"; it may, however, be noted that the author of that paper looks upon the coalfields of Belgium and Northern France, now in German hands, as valuable pledges to be used in the ultimate peace negotiations. Another speaker emphasises the impossibility that a nation with a production of twenty million tons of coal (*i.e.* France) should be able to conquer Germany with its production of more than 300 million tons; he must rate the intelligence of his audience very low if he thinks that it will not carry this comparison far enough to add the coal production of Britain and of the United States to that of France. Where would his comparison stand then?

The second paper constitutes a variant upon the theme which we have heard before: the imperative need that the French Briev and Longwy iron-ore fields should be retained in German hands, being the "essential natural requirement," in view of future wars of the German Empire—"Empire that has been attained by blood and maintained by blood," as one of the speakers at the dinner called it. Of course, the demand for the retention of these iron supplies is masked by the pretext that it is put forward in the interests of the German working-man; no hint is given that it is the vast profits to be derived from these rich iron-ore fields that the German ironmasters have all along had in view. No one who knows anything of German economics can doubt that this war could never have been begun had it not been for the willing concurrence of the great German ironmasters—and the price that they demanded for their assistance has now been made plain. Moreover, if it be true, as rumour persistently asserts, that the Kaiser's interest in the great Krupp ironworks is not a purely platonic one, pursuit of material gain may have proved nearly as powerful an incentive as autocratic ambition; and to these ignoble motives millions of human lives have been brutally sacrificed. H. L.

VIBRATIONS OF TALL CHIMNEYS.

FROM the point of view of stability, measurements of the vibrations of tall chimneys are important, especially in a country like Japan, which is subject to severe earthquakes. Experiments on three chimneys of concrete reinforced by steel rods are described in a valuable paper by Prof. Omori, published in the Bulletin of the Imperial Earthquake Investigation Committee (vol. ix., 1918, pp. 1–29). One of these chimneys, erected by the Kuhara Mining Co. at Saganoseki, is the tallest in the world. It is 550 ft. in height, 42 ft. 8 in. in diameter at the base and 27 ft. 5 in. at the top, the thickness of the wall being 29½ in. at the base and 7 in. at the top. The total weight of the structure, including the foundation, is 9500 tons, and the pressure of the shaft on the ground below is three tons per square foot.

When the chimney was finished measurements were made on five days (December 22–26, 1916) by means of two horizontal vibration recorders fixed to the top of the wall. The wind at the top attained a velocity of 24 metres per second on the first day, and the high value of 35 metres per second on the last; on the three intervening days it never exceeded 7 metres per second. With the latter velocity the vibrations of the chimney were insignificant, but they increased rapidly with the strength of the wind, the range (or double amplitude) being 20 millimetres in the direction of the wind and 186 millimetres at right angles to it. The period of the vibrations was almost constant, and varied from 2·52 to 2·58 seconds, the maximum acceleration on December 26 being 565 millimetres per second per second, or nearly one-third more than that of the semi-destructive Tokyo earthquake of 1894. Prof. Omori notices that the period of vibration is distinctly greater than that of the strong vibrations of a great earthquake (which is usually from 1 to 1½ seconds), and concludes that, in a district such as Saganoseki, in which the earthquakes are by no means violent, the effects of wind-pressure are likely to be more important than those of earthquake motion.

VIBRATIONS: MECHANICAL, MUSICAL, AND ELECTRICAL.[1]

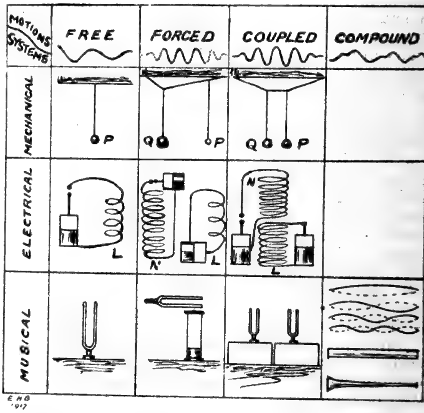
I.—*Introductory Survey.*

THE subject of vibrations is a large one. It comprises a great variety of to-and-fro motions, and these may be executed by diverse systems at widely differing rates. Near one border of the subject lie phenomena so simple that a child may grasp their leading features. Near the opposite border there are phenomena of exceeding complexity, and their full solution is still awaited.

It thus appears that parts of the subject are too elementary and familiar for detailed treatment here, while others may be not yet ripe for general description. But between these extremes there are portions or aspects of the subject that may prove both interesting and practicable.

To indicate and locate a few such portions, a brief survey of the subject was then taken. Many ways of classifying vibrations are available. But without aiming at logical precision, a somewhat rough method was considered convenient. Thus, since a vibration is a to-and-fro motion, the various types of such motions may be placed in columns. Secondly, since these motions are executed by some physical systems, the various systems may be placed in rows or lines. This gives the subdivision shown in Table I.

Table I.—*Typical Vibrations.*



Neither the columns nor the rows need stop just where they do in this table, for the subject extends further in each direction. Moreover, each column and row admits of further subdivision, so that the ramifications of the subject are almost beyond enumeration. But, as it is, it serves to locate the portions to which chief attention was directed. These were examples of two or more associated vibrations, whether forced, coupled, or compound.

II.—*Forced and Coupled Vibrations.*

Forced and *coupled* vibrations must be distinguished from each other and from the simplest class of all, called *free* vibrations. To do this, pass along the first row in Table I., taking the cases of the pendulums there shown.

If a pendulum-bob is pulled aside and let go, it returns towards its zero position under the combined effect of gravity and its slant suspension. On reaching the zero position with a certain velocity, it overshoots the mark because the bob has inertia. Thus a free vibration is set up. This may continue until slowly extinguished by friction, which is operating all the time to diminish the swings. Next, let the point of suspension of a pendulum be moved slightly to and fro by periodic forces. Then the pendulum would be set in vibration and kept going. Further, the motions would settle down to a quite definite amplitude and phase. These are *forced* vibrations. Their amplitude would depend upon that of the point of suspension, and also on the *tuning*. By tuning is meant the degree of agreement between the period natural to the pendulum and that of the forces applied to it. The closer the tuning between them, the better the response. Upon the tuning depends also the *phase* of the forced vibrations. When the forces alternate appreciably more slowly than the vibrations natural to the pendulum the two are almost in like phases. But when the forces alternate more quickly than the pendulum the latter swings almost in opposite phase.

This change of phase of forced vibrations was illus-

[1] Abstract of a discourse delivered at the Royal Institution on Friday, March 8, by Prof. Edwin H. Barton, F.R.S.

trated by three pendulums, all hanging from the same tightly stretched horizontal cord. One pendulum had a heavy bob, and by its swings moved the stretched cord. It thus acted as *driver*, and applied forces to the other two pendulums, which had light bobs, and so were easily *driven*. Of these pendulums one was shorter and one longer than the driver. They soon settled to opposite phases after the heavy bob was set in motion. *Resonance curves* showing the varied responses of such driven pendulums as the tuning is altered were then thrown on the screen.

In the cases just dealt with the light bob is set in motion at the expense of energy taken from the heavy one. But on account of the great disparity of the bobs, this loss entailed no appreciable diminution in the vibrations of the heavy bob or driver.

Consideration was next given to the case where equal bobs hang from a tight cord. While both pendulums are hanging at rest one bob is struck. Its vibrations disturb the other pendulum and set it in motion. But, obviously, while the driven pendulum gains an amplitude equal to that first possessed by the driver, the driver itself would have lost all its motion. The other then becomes the driver in turn, and transfers its energy back to what was originally the driver.

This palpable surging of the energy to and fro between the two pendulums marks them as showing what may be called *coupled* vibrations. In both cases the action of the driver on the driven is recognised. But in the case of coupled vibrations the *reaction* of the driven on the driver is palpable and recognised also, whereas in what are called forced vibrations this reaction is undiscernible or ignored.

In the case of coupled vibrations just shown the vibrations of each pendulum seem quite simple, but slowly and alternately wax and wane in amplitude—that is, they exhibit what are termed "*beats*." But it is well known that beats may be heard when two musical tones of slightly differing pitch are sounded together. Further, the number of beats per second is the difference of the frequencies of the two tones. Thus the waxing and waning vibrations of either pendulum may be regarded as the superposition of two simple vibrations of slightly different periods.

The next case studied was that of two precisely similar pendulums connected by hanging one from the bob of the other. One bob being started by a blow, it appeared to execute simple vibrations. The other moved with a pause or twitch instead of in simple fashion. Further, neither pendulum showed the waxing and waning of amplitude which was so marked in the other case where both hung from a stretched cord.

The questions which now naturally arise are:—(*a*) Why this contrast? and (*b*) Can the gap be bridged? The solution is simple. The difference in appearance is only a matter of different ratios of periods of the superposed vibrations, and this, again, is due to different values of the *coupling*, to borrow a term from electrical theory. We have changed suddenly from a very loose to a very tight coupling. We consequently passed at a bound from periods nearly equal (giving a slow waxing and waning) to periods the ratio of which exceeds 2 : 1 (involving the pause or twitch); for the theory shows that as the coupling increases the ratio of the periods increases also.

It is accordingly of interest to change the coupling gradually and so bridge the gap between the two motions which seemed so unlike. This was done by the cord-and-lath pendulum, in which the cord pendulum is suspended from an adjustable stud on the lath pendulum. When the two suspensions are near together, the value of the coupling is almost equal to the fraction of the lath-length at which the cord is attached. When this fraction is unity, as in the case of one pendulum hanging from the bob of the other, the coupling has the value $1/\sqrt{3}$, or 58 per cent. nearly. (These simple relations are for equal bobs and equal pendulum lengths.)

III.—*Electrical Vibrations, Forced and Coupled.*

On passing along the second line of Table I. it was noted how the various types of electric vibrations may be obtained and the striking analogy to them presented by the mechanical cases already considered.

Any electrical circuit containing a capacity and an inductance may exhibit electrical vibrations. For the fundamental electrical conditions are there present, just as the mechanical ones were in the case of a simple pendulum. If the condenser is charged by a suitable means, the quantity of electricity so displaced is urged to flow back again round the circuit by the electromotive force of the charged condenser. If the resistance of the circuit is small enough, the electromagnetic inertia (measured by the inductance) ensures that the current shall still flow after the condenser is discharged. Thus its charge is reversed. So the vibrations continue until the energy is dissipated by the resistance of the circuit. These are *free* electrical vibrations.

As an example of forced electrical vibrations we may think of a circuit with capacity and small inductance (like that of a Fleming cymometer) placed not too near to a circuit of similar frequency, but with much greater inductance. Then the cymometer will respond to the vibrations of the other—*i.e.* it will execute *forced* vibrations. These will not appreciably diminish the vibrations of the main circuit.

But let two electrical vibration circuits of comparable inductances and periods be placed together and started, then there is not only the action of the driver, but also a distinct *reaction* of the driven on the driver. Hence, as the vibrations of one circuit start those of the other, the latter by their growth check the former, causing them to die away. Thus there may be an interchange of energy between them. This, as we have seen with pendulums, corresponds with the superposition of vibrations of slightly differing periods, provided the action and reaction are small and the interchange slow. Further, it is known that if two such circuits are closely coupled, these two periods differ more widely. Hence a third circuit (say a cymometer) responding to either of them may detect these separate periods by giving a resonance curve with two humps instead of one.

IV.—*Traces from Coupled Pendulums.*

It has been seen that there is a certain general analogy between mechanical and electrical vibrations, whether free, forced, or coupled. The question now arises as to whether this analogy may reach or approach a quantitative exactness in all or any respects, and whether it can be utilised in any way.

Various mechanical vibrating systems differ widely. Some resemble the electrical case very closely, but none appears to be completely and exactly analogous to them in every detail. Indeed, the electrical case seems to be slightly simpler than any mechanical analogy yet put forward. But the differences are small, and the mechanical analogy may be highly useful as affording visible and tangible illustrations of those subtle electrical vibrations which can be neither seen nor handled. Especially is this the case if the model is readily adjustable to represent the various relations of the constants concerned and can be used for any initial conditions. Thus from such analogies some benefit may accrue to the non-mathematical student. But perhaps the highest advantage is realised only by those who combine the mathematical with the experimental study, and grope after the ideal model which shall represent exactly the electrical or other phenomena in question. But, whatever the uses of

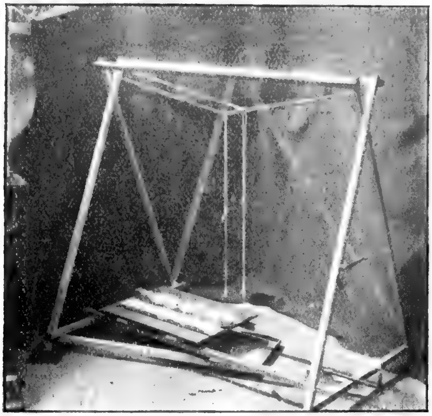


FIG. 1.—Coupled pendulums.

such models, certain it is that their design and study have appealed to many eminent men of science. In this connection it may suffice to mention Faraday, Maxwell, Lord Kelvin, Lord Rayleigh, Sir Oliver Lodge, Sir Joseph Thomson, Profs. J. A. Fleming, T. R. Lyle, of Australia, and W. S. Franklin, of America.

For either quantitative work or mere illustration the usefulness of such a model is much enhanced if its vibrations leave traces. This is easily arranged by letting the bobs carry funnels of sand under which a blackboard moves uniformly at right angles to the direction of vibration. In the portable apparatus shown in Fig. 1 the pendulums are of the double-cord type, and allow both traces to be obtained simultaneously and thus record the relation of amplitude and phase for each pendulum.

With this apparatus the coupling can be varied at will, and easily adjusted to any desired value from 1 per cent. to 60 per cent. or more. The greater the droop of the bridles, the greater the coupling, the quantitative relation being simple. It is noteworthy that for equal bobs and pendulum lengths a 60 per cent. coupling gives superposed periods as 2 : 1, just as in the electrical case for equal periods. Indeed, with any specified coupling the ratio of period is the same for this mechanical case and for the electrical one. The masses of the bobs and the lengths of the pendulums are adjusted at pleasure, and the initial conditions may be anything that is desired. (Simultaneous traces with this apparatus were then obtained, others exhibited, and photographs of a number thrown on the screen. One set of traces illustrated the *rapidly damped* vibrations of the *quenched spark,* and the corresponding *almost undamped* vibrations on the *antenna* in this system of wireless telegraphy.)

With equal bobs and equal lengths, the coupling being small, each pendulum exhibits in turn the same maximum and the same minimum as the other. With small couplings, equal lengths, but bobs as 20 : 1, the case of forced vibrations is approached. That is to say, the heavy bob loses but little amplitude, while that of the light bob grows from zero to its maximum. With bobs as 5 : 1, the heavy bob loses appreciably, while the light one proceeds to its maximum.

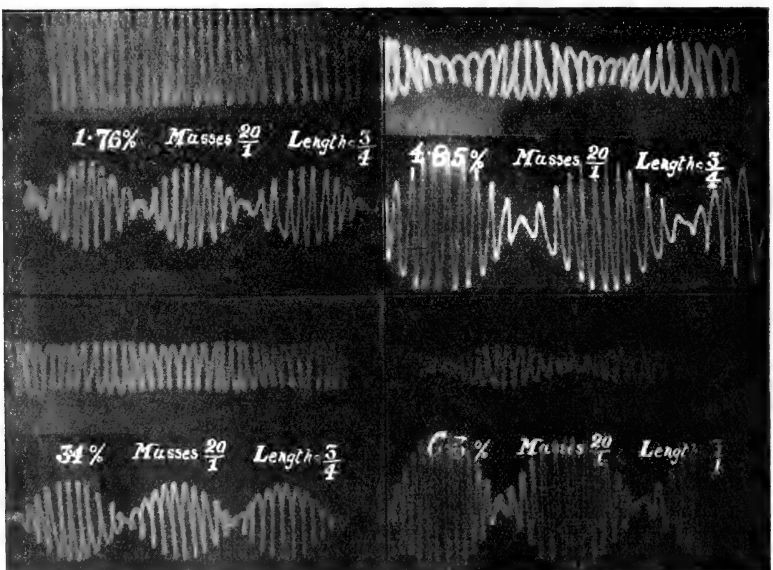


FIG. 2.—Vibration traces of coupled pendulums.

As the coupling increases from zero, the ratio of the periods of the superposed vibrations of the coupled pendulums usually increases continuously until it equals or exceeds 2 : 1. When, however, both lengths and masses are unequal, the *short* length having the *heavy* bob, a new feature appears. As the coupling gradually increases from zero, the ratio of the periods at first *diminishes*, reaches a *minimum*, and then *increases*. Thus the number of vibrations in a beat cycle at first *increases*, reaches a *maximum*, and then *decreases*. These special effects are shown in Fig. 2. They were theoretically predicted and then experimentally confirmed. The maximum number of vibrations in the beat cycle occurs for the highest coupling shown in the figure, viz. 6·3 per cent. The details as to bobs, lengths, and couplings are all indicated in the figure. The able collaboration of Miss H. M. Browning in this work was gratefully acknowledged.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Glasgow.—The Ferguson fellowship in applied chemistry, founded this year, is in the gift of the trustees of the Ferguson Bequest Fund, and is of the annual value of 200*l*.; it is ordinarily tenable for two years, subject to the fulfilment of the prescribed conditions. Candidates must be graduates in science of the University of Glasgow who have completed the curriculum for a degree in applied chemistry, or have taken chemistry as a principal subject in the Final Science Examination for a degree in pure science. The fellow is required to devote himself, during the tenure of his fellowship, to research in relation to some branch or branches of applied chemistry approved by the fellowship committee. His work may be carried out at the University, the Royal Technical College, or elsewhere, as the fellowship committee may direct. Candidates for the Ferguson fellowship for 1918 should, in the first instance, send their names to the registrar of the University early in the first term of the session 1918–19.

Science announces that gifts to Yale University in the past year and credited as endowment made a total of 256,000*l*. From time to time gifts have been announced, but the new items included 20,000*l*. as the Earl Williams Fund from Mrs. J. H. Williams for the benefit of the University Press, and 80,000*l*. from William L. Harkness as a building fund.

Prof. T. Brailsford Robertson, professor of biochemistry and pharmacology in the University of California, has been appointed professor of biochemistry in the University of Toronto. Prof. J. J. R. Macleod, professor of physiology and biochemistry in the Western Reserve University, has been appointed professor of physiology in the same University.

In view of the practical impossibility while the war continues of holding the A.M.I.E.E. examination and of candidates having the requisite time to prepare for or undergo examination, the council of the Institution of Electrical Engineers has decided to suspend temporarily the institution rules in regard to examination. The greatest care will, nevertheless, be exercised by the council to ensure that only candidates possessing the qualifications laid down in the articles in respect of training and experience are admitted to associate membership.

On Speech Day at King's School, Canterbury, on July 24, Mr. A. Latter, the headmaster, announced that as a permanent memorial to their son, William Frederick Drughorn, an old King's scholar, killed in action, Mr. and Mrs. J. F. Drughorn proposed to endow the school with laboratories, to be known as the Drughorn Science Buildings, at a cost of 25,000*l*., subject to arrangements being made for outside students to have access to them. Mr. Drughorn, he said, wishes "to encourage scientific education in the country, and hopes that the scheme will be a means to our future defence against a repetition of the peaceful scientific invasion of our present unscrupulous enemies, to whom these buildings will be closed."

At the ninth biennial vacation course, which meets in the Oxford School of Geography on August 1–16, special attention is being devoted to some geographical aspects of the Empire, while both in the lectures and in the practical geography classes (for the study of climate, land-forms, the home region, and exploration) various general problems are to be discussed. Excursions to places of geographical interest in the vicinity of Oxford have been arranged. The course is specially designed to be of service to teachers both in secondary and in elementary schools. Earl Denbigh is to lecture on "German Aims and the Causes of the War." In addition to the members of the staff of the Oxford School of Geography the lecturers will also include the Master of Balliol, Prof. F. Haverfield, Prof. C. Grant Robertson, Prof. Grenville A. J. Cole, and Prof. P. M. Roxby. Particulars of the course may be obtained from the Secretary, School of Geography, University of Oxford.

A committee entitled the Officers University and Technical Training Committee has been appointed "to advise the Board of Agriculture, the Board of Education, the Ministry of Labour, and the Ministry of Pensions upon such courses of education and training as it may be desirable to arrange for the benefit of officers and ex-officers of H.M. Forces and men of like standing, particularly with the view of fitting them for suitable employment after the war; to consider any general questions arising in connection with such education and training, and when necessary to advise individual officers as to suitable courses of training." Among the members of the committee are:—Capt. W. D. Ross, University of Oxford; Mr. H. A. Roberts, University of Cambridge; Sir William Collins, University of London; Sir William Ashley and Prof. W. Ripper, Universities of Birmingham, Durham, Leeds, Liverpool, Manchester, and Sheffield; Principal E. H. Griffiths, Universities of Wales and Bristol; Mr. F. Wilkinson, Association of Technical Institutions; Mr. W. A. Nicholls, Workers' Educational Association; Mr. C. B. L. Tennyson, Federation of British Industries; Mr. Howard Martin, Surveyors' Institution; Sir Charles Bathurst, M.P., Central Chamber of Agriculture; and Mr. A. M. Samuel, Association of Chambers of Commerce. Lt.-Gen. Sir Alfred Keogh is the chairman of the committee, and the secretaries are Mr. G. H. V. Sutherland, of the Board of Education, and Mr. F. J. Bullen, of the Appointments Department, Ministry of Labour.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, July 8.—M. P. Painlevé in the chair.—The president announced the death of Charles Wolf.—G. **Bigourdan**: Notice on the life and work of Charles Wolf.—G. **Humbert**: The representations of an integer by indefinite, ternary, quadratic forms.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: The effects of isotonic intravenous injections in hæmorrhage. From experiments on dogs in cases of grave hæmorrhage the authors recommend extensive intravenous injections. The percentage of red corpuscles is lowered, but the mass of the blood is increased.—G. A. **Boulenger**: The relations of ontogeny to taxinomy in Batrachians.—MM. **Dimier** and J. **Bergonié**: The search for the guinea-worm by radiography. This parasite can be detected by the X-rays.—R. **Jonckheere**: Observations and identification of the new star in Aquila. Observations of magnitude were made on June 8, 9, 10, 11, and 12. The new star has been identified with one recorded on photographs taken at Johannesburg (August, 1910) and at Algiers (August, 1909, and June, 1895).—A. **Véronnet**: The maximum temperature of a star undergoing condensation.—A. **Leduc**: The density, compressibility, and atomic mass of argon. The numbers for density and atomic mass do not differ appreciably from those given by Ramsay and Travers.—Q. **Majorana**: Experimental demonstration of the constancy of the velocity of light emitted by a moving source. The source of light was a rotating mercury arc, with a peripheral velocity of 90 metres per second, and the light was examined by a Michelson interferometer.—P. **Weiss**: A property of ferro-magnetism.—P. **Boucherot**: Calculation of the propagation of alternating currents on long lines by the separation of the real and reactive powers.—E. **Bélot**: The experimental reproduction of mountain folds on the hypothesis of a horizontal displacement of the internal layers.—L. **Gentil**: The extension into Andalusia of strata in the province of Cadiz.—P. **Wintrebert**: The disjunction of the nervous and muscular functions at the period of latent automatism in the embryos of *Scyllium canicula*.—H. **Marichelle**: The theory of vowels and its applications to auditive re-education.—E. **Maignon**: The influence of the species of animal on the toxic power and mode of utilisation of the food proteins. The foods employed were white of egg, casein, and meat-powder; the effects on the dog and white rat are compared.—P. **Portier** and H. **Bierry**: The importance of the ketonic function in metabolism. Ketone formation by symbiotes. The pentoses (arabinose and xylose), the hexoses (glucose, levulose, galactose, sorbose), the bioses (saccharose, etc.), and certain polyalcohols (glycerol, mannite) are, in suitable media, attacked by symbiotes, giving, besides other products, acetyl-methyl-carbinol, $CH_3.CO.CH.(OH).CH_3$.—M. **Heitz-Boyer**: The mechanical reduction of fractures.—M. **Quénu**: Remarks on the preceding communication.

PETROGRAD.

Academy of Sciences, November, 1917.—V. L. **Bianchi**: Fundamental conceptions of zoogeographical divisions.—M. N. **Rimskij-Korsakov**: Note on the aquatic Hymenoptera in the collections of the zoological museum of the Russian Academy of Sciences.—A. A. **Markov**: Generalisation of the problem of the successive exchange of balls.—O. **Kuzeneva**: List of the plants collected by the expeditions for exploring the basin of the Zeja, in the Amur province.—V. I. **Palladin** and V. P. **Illiuviev**: The formation of zymase in plants.—K. M. **Deriugin**: Obituary notice of the zoologists V. Ja. Lazdin and N. V. Prosvirov, killed in the Pamirs in 1916.—E. H. **Rosenthal**: Magnetic observations made in the Baltic governments in the summer of 1914.—N. M. **Krylov**: Various generalisations of the method of W. Ritz, and certain questions connected therewith.—V. A. **Steklov**: Remarks on quadratures.—N. I. **Andrusov**: The geological structure of the bed of the Straits of Kertch.—L. Ja. **Sternberg**: The Chinese heavenly twins from the point of view of comparative ethnography. (A reply to the article by V. M. Alekséjev: The immortal doubles of China and the daos with the golden toad.)—P. B. **Struve**: Preparatory studies on the history of political economy in Russia. I. To what school of economics did Henri Storch belong? II. History of political economy published in 1836 by Helmuth Winter, professor at Kazan University. The conception and the problem of commercial politics.—A. F. **Zaicev**: M. N. Katkov's views on Russia's commercial policy during the period 1860–80.

BOOKS RECEIVED.

The Main Currents of Zoology. By Prof. W. A. Locy. Pp. vii+216. (New York: H. Holt and Co.)

The Theory of the Relativity of Motion. By R. C. Tolman. Pp. ix+225. (Berkeley: University of California Press.)

Electrical Experiments. With 52 Diagrams and Full Details of Apparatus and Method of Procedure in about 80 Exercises. By A. Risdon Palmer. Pp. xii+115. (London: T. Murby and Co.) 1s. 6d. net.

Magnetic Measurements and Experiments. With 52 Diagrams and Numerous Fully-worked Examples. By A. Risdon Palmer. Pp. 124. (London: T. Murby and Co.) 1s. 6d. net.

The Statics of the Female Pelvic Viscera. Vol. i. In which the Evidence of Pathology, Phylogeny, and Ontogeny, and Clinical Investigation, etc., is Surveyed. By Dr. R. H. Paramore. Pp. xviii+383. (London: H. K. Lewis and Co., Ltd.) 18s. net.

The Strategic Geography of the Great Powers. Based on a Lecture Delivered during 1917 to Officers of the Grand Fleet and to the British Armies in France. By Dr. V. Cornish. Pp. viii+114. (London: G. Philip and Son, Ltd.) 2s. net.

The Life of Sophia Jex-Blake. By Dr. Margaret Todd. Pp. xviii+574. (London: Macmillan and Co., Ltd.) 18s. net.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, AUGUST 8, 1918.

AGRICULTURE IN THE WESTERN STATES.

(1) *Western Live-stock Management.* Edited by Prof. Ermine L. Potter and others. Pp. xiv+462. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 10*s*. net.

(2) *Soil Physics and Management.* By Profs. J. G. Mosier and A. F. Gustafson. (Lippincott's College Texts: Agriculture.) Pp. xiii+442. (Philadelphia and London: J. B. Lippincott Co., n.d.) Price 8*s*. 6*d*. net.

THE Anglo-Saxon race always tends to look westwards in time of trouble, and it has usually found comfort there. Horace Greeley's famous advice, "Go west, young man," expresses a deep-seated feeling which years of emigration have only served to intensify. Once again the West is looming large in the history of civilisation, and this time the Allies are looking there for food and men. The books before us deal with the agricultural conditions, and are, therefore, assured of a hospitable reception from agricultural students.

(1) Prof. Potter, of the Oregon Agricultural College, breaks new ground in his treatment of "Western Live-stock Management," and gives an account of what Western stock-keepers are actually doing in the way of raising and feeding their cattle. Real improvement, the author insists, must be based on accurate knowledge of present practices.

By the West the author understands the region lying between the one-hundredth meridian and the Pacific Ocean—the western parts of the Dakotas, Nebraska, Kansas, and the eleven States west thereof. In the main it lies high, most of it above 2000 ft.; otherwise, however, there are great topographical diversity, immense plains, rolling hills, and the wildest and most rugged mountains. Generally speaking, the soil is good. Climatically, the most notable characteristic is the low rainfall; excepting the western parts of Oregon and Washington, almost the entire region has less than 10 in. of rain per annum. The dry climate and high altitude make the summers cool, particularly at night; the winters are mild, except in the north, and, as their coolness is mitigated by the dryness, they are more comfortable for men and beasts than those in the eastern States.

These soil and climatic conditions determine largely the type of husbandry, and it is not surprising that grazing is the main industry. Most of the land still belongs to the United States Government, and is called Federal or Government land; a good deal of this is forest reserve grazed only by those possessing permits from the forest supervisor. The rates payable for sheep are 15–16 cents per head per annum; for cattle, 60–64 cents; for horses, 75–80 cents; and for pigs, 36–38 cents. In Texas, however, much of the land is "deeded" in private ownership, whilst elsewhere there is a good deal of unappropriated land not reserved for forests and not hitherto thought good enough for homesteading. This "free range" amounts to 290,000,000 acres, but it is not so helpful as it looks to the man who wishes to make a living out of nothing, because no one is entitled to take steps to save hay; if anyone does so he cannot prevent someone else from making off with it.

Most of the ranges are covered with sage brush in the north, and with chaparral and similar shrubs in the south. Scattered throughout is a certain amount of grass, which, however, tends to grow in clumps or bunches, instead of scattering over the surface as a sod: hence the name "bunch grass" generally given to grasses in the region. As might be expected, the stock-carrying capacity is low. On a good Leicestershire pasture one acre satisfies one bullock for the season; on a Western range 30–40 acres would be required in the summer and an additional area in winter. Improvement comes as soon as tillage land is added; dry farming has already done something in this direction, and may do more. Still greater improvement can be effected by modifying the grazing system. Most of the range grasses reproduce by seed, and if they are eaten down so closely that they never mature seed they are finally killed out; on the other hand, if they are allowed to form seed they can hold their own indefinitely. By arranging to defer the grazing until after seeding time on one-quarter of the range each year, it is possible to ensure a thorough seeding once in four years, which is found to be sufficient.

It is not necessary to follow the author in his details of management. These are set out clearly, and cannot fail to interest the professed agricultural student who wishes to learn something about ranching.

(2) Profs. Mosier and Gustafson work at the Illinois Agricultural Experiment Station, and while their subject is of general interest, their illustrations are necessarily largely drawn from the great Middle West, and especially from their own State and from Kansas. Soil physics has always attracted much attention in the States ever since Kedzie at Michigan and King at Wisconsin brought out the intimate relationship between cultivation and soil moisture—often a limiting factor in American agriculture. The authors devote a large section of the book to this relationship, and they show that it is much more complex than was at first supposed. Repeated cultivation, for example, which was considered to increase soil moisture and crop production by breaking "capillary films," and thus stopping the escape of water to the surface, is shown in practice to lead to little or no increase in crop. So subsoiling, which had been supposed to increase soil moisture, was found to be ineffective in increasing cereal crops; deep ploughing, however, proved much more useful. An interesting experiment is described that we should like to see repeated in this country. A plot of maize at the Illinois Experimental Station was subdivided; one part was kept well hoed; a second had all weeds destroyed by the hoe, but was otherwise untouched; a third was left un-

touched after sowing, so that weeds came up; a fourth was also left untouched, but sufficient water was added to provide for all the needs of crop and weeds, and to allow of full crop growth if the water supply were the limiting factor. The largest yield—48·9 bushels—was obtained from the plot on which weeds were destroyed; next—with 43·3 bushels—came the well-hoed plot—quite an unexpected result, which, however, leads the authors to an interesting discussion; thirdly came the watered plot with weeds, which yielded ten bushels; and only a little behind—with 7·4 bushels—came the plot that had received no water. It is thus clear that the effect of weeds is not merely to deprive the crop of water. The authors conclude that it must therefore have deprived the crop of food. We would commend to them the papers of Mr. Spencer Pickering on the effect of one growing plant on another.

The chapter on cultivation implements gives illustrations and descriptions of types not generally familiar to English students. Disc ploughs and sulky ploughs are known to some, but listers, spading disc harrows, culti-packers, and weeders will be new to most people here. We should like to have seen this section extended to include a wider discussion of the effect of these implements on the soil—a subject on which the authors could give much valuable information. If need be, space could be found by giving up the sections on fertilisers and some of the geological portions of the opening chapters, which, good as they are, need not necessarily come into a book on soil physics. The authors have done useful service in bringing together so much interesting American material. We may hope one day for a book in which the English and European results will be discussed so that we can compare them with those set out here.

E. J. RUSSELL.

THE INTERNAL EAR.

An Inquiry into the Analytical Mechanism of the Internal Ear. By Sir T. Wrightson, Bart. With an Appendix on the Anatomy of the Parts concerned by Prof. A. Keith. Pp. xi+254+plates ix. (London: Macmillan and Co., Ltd., 1918.) Price 12*s*. 6*d*. net.

THIS volume is a striking example of the co-operative method in scientific research. The problem is the mechanism and functions of the internal ear, especially of the cochlea, a problem the solution of which has enlisted the attention of physicists, physiologists, and anatomists with more or less success. One associates with the cochlea the names of Bowman, Corti, and Helmholtz, besides many others, but this is the first occasion when it has been studied by an experienced engineer working alongside a learned anatomist. Sir Thomas Wrightson, since 1876, has been deeply immersed in acoustics, and he has brought to bear on the cochlea much technical knowledge, derived from wide and varied experience as an engineer. He has associated with him Prof. Arthur Keith, an anatomist, familiar with structure, fertile in imagination, and skilful in interpretation. It would be difficult to conceive a combination of workers more suitable for the investigation of that remarkable mechanism by which sound-waves act on the ear and affect the terminations, or, rather, the beginnings, of the auditory nerve.

The work consists of two parts: (1) The first chapters by Sir Thomas Wrightson, dealing with acoustics chiefly from a theoretical point of view, but always linked with our knowledge of the cochlea; and (2) an appendix, subdivided into parts i. and ii., by Prof. Keith (the curator of the museum of the Royal College of Surgeons), dealing with the mechanism of the internal ear, especially of that all-important portion, the organ of Corti, microscopical in detail, and difficult of interpretation. From one point of view, the sense of hearing is a modification of the sense of touch, which in its turn is a sense of pressure. Between the pressures of sound-waves and the nerve terminals there is an elaborate apparatus for receiving these pressures and converting them into nervous impulses. Further, sound-waves vary in number, or frequency, in amplitude, and in form, and the intermediate apparatus is adapted to the detection of these variations.

Sir Thomas Wrightson discusses the nature of simple, compound, and differential tones, illustrating these graphically by tracings taken by an instrument invented by himself called the ohmograph, and from these tracings information is obtained as to the variations in wave-form, wave-composition, and velocities at different parts of the tracing. A compound wave is resolved into its constituents, each constituent corresponding with a simple tone, or simple pendular movement, blending with others to form a resultant tone. The various curves cross each other at certain points. In an air-wave these points or crossings indicate points of pressure on the fluid in the cochlea, and ultimately on the nerve terminals. Pressures are indicated on the "cross" and the "trough," and thus a wave form, in a simple pendular movement, shows phases. Each complete sound-movement consists of four phases, and each phase acts against resistance more or less elastic. These views are illustrated by elaborate diagrams, and they may be said to lie at the foundation of the author's theory of the cochlea. There is no necessity for calling into play the principle of resonance, and consequently the author entirely abandons the theory of Helmholtz, which was founded on the conception of resonance. It is not in resonance that there is an explanation, but in the detection of variations of pressure.

By means of Seebeck's siren it is demonstrated that several musical tones may be heard without confusion. Sir Thomas Wrightson applies this principle to the phenomena of beats, and to differential and summation tones. It is doubtful, however, whether the ear can distinguish between a push and a pull. The author then proceeds to a consideration of the inner ear, especially as to changes in the velocity of particles of the perilymph in different parts, depending on the degree of resistance to be overcome.

There is an elaborate chapter on the calibration of the cochlea, showing the ratio of the areas of the various membranes concerned, the measurements of the cochlea at different portions of its course, and the manner in which these influence the hairlets in their bendings. In simple and compound tones, the movements of the hairlets correspond in time with the crests, crossing points and troughs of the waves. Considering the mechanism as an engine, the piston is really the basilar membrane, and the movements are communicated to the membrana tectoria, and through it to the hairlets connected with the hair-cells. At p. 153 the interesting suggestion is made that if it could be proved that a nerve current passed continuously through the points at which the tips of the hairlets impinge on the membrana tectoria, a kind of microphonic action might take place which would modify the conversion of mechanical impulses into nervous irritation—that is, the conversion of mechanical into nervous impulses.

The second part consists of an appendix, in which Prof. Keith gives an historical and critical account of the structure of the ear. The historical portion is especially valuable, showing the development of knowledge from the time of the anatomists John and Charles Bell onwards. Special mention is made of the contributions of Bowman, who was one of the pioneers in describing the structure of the spiral laminæ and basilar membrane and the so-called muscle or ligament. Then followed Corti, Kölliker, Deiters, and Henle, who all investigated Corti's organ and prepared the way for Helmholtz. That German physiologist, taking the cue from Hensen, formulated the view that the function of the organ was to convert compound into simple pendular vibrations. The organ, according to Helmholtz, was analytic in its function. Although it was difficult, almost impossible, for the anatomists, from the small dimensions of its parts, to accept this explanation, it was generally admitted by physicists, as it seemed to meet the difficulties of the case. Prof. Keith submits the matter to a rigorous analysis, and draws the conclusion that there are no anatomical structures which serve as resonators in the cochlea. Generally, he applies Sir Thomas Wrightson's explanation with some modifications and refinements, and he is unable to follow Helmholtz. In particular, he attaches importance to the connection between the hairs or hairlets of the cells and the tectorial membrane. Each small group of hairs, surrounded by the fibres of the membrana reticularis, fits into a depression on the under surface of the membrana tectoria. The basilar membrane, although consisting of fibres arranged in parallel lines, cannot differentiate for separate tones, as the fibres are united side by side and cemented together. It cannot, therefore, be the analytic organ, and the anatomist is obliged to pass upwards to the hairlets and the membrana tectoria.

The impression one has, after perusing this book, is that this study of the cochlea makes the organ complicated and less easy to understand. If analysis takes place in the cochlea, suitable structures must be met with there which physically would suit the purpose; if analysis does not occur in the cochlea, why should there be such differentiation of structure? In other words, how can we account for the elaboration of the basilar membrane, hair-cells, hairlets, and reticular and tectorial membranes, when a direct stimulation of nerve-endings would have served the purpose? Then the principle of resonance, in its real application, would still be serviceable, although the structures were of almost inconceivably minute size. The theory of Helmholtz, although it bristles with obvious difficulties, has at all events the merit of simplicity. We must not forget, also, that minute differences in structure may be morphological other than physiological. This, no doubt, cuts both ways, but it does away with the necessity for having a physiological explanation of every structure, however minute. The Helmholtz theory does not explain, for example, the cochlea in the bird, and it is not the last word in the discussion. It may be contended, however, that it serves a purpose that is understandable. The alternative is to relegate the whole matter to a wilderness of anatomical facts, and we may give up all attempts at explanation by the hypothesis that analysis of compound tones—in short, musical analysis—is a function of nerve-cells in the grey matter of the cerebrum, of which we know next to nothing.

Both authors deserve great credit for a valuable contribution to our knowledge of the subject. The illustrations are admirable, and there are many new sections prepared by Prof. Keith. The reasoning is lucid and suggestive. J. G. M.

OUR BOOKSHELF.

L'Evolution des Plantes. Par Prof. N. Bernard. Préface de J. Costantin. Pp. xxxii+314. (Paris: Librairie Félix Alcan, 1916.) Price 4·55 francs.

NOËL BERNARD was elected professor of botany at Poitiers in 1908 and died, at the age of thirty-six, in 1911. Prof. Costantin, in a preface written at the request of Madame Bernard, gives an interesting account of the life and work of his old pupil. Bernard was a man of wide culture and considerable ability, who devoted most of his scientific life to the experimental investigation of the germination of orchids, with special reference to their symbiotic association with fungi. The concluding chapter of this posthumous volume is a reprint of the introduction to his important paper on "L'Evolution dans la symbiose" published in the *Annales des sciences naturelles* in 1909.

The book is characterised by conciseness and clearness, qualities which one expects in the writings of French authors. The first part treats of the general laws of evolution, the evolution of the individual soma and of sexual reproduction, the idea of species, the inheritance of characters, species and varieties, Mendelism, and other subjects inseparable from the main thesis. Part ii. consists of concise summaries of the morphology and reproduction of the higher plants, and in part iii. some hypotheses are briefly considered and summed up in the following words:—"Les problèmes sur l'évolution que soulève l'étude morphologique des végétaux resteraient de creuses et inutiles discussions verbales si elles ne devaient pas conduire à des expériences qui permettront sans doute un jour de comprendre cette évolution assez précisément pour la diriger."

"The Evolution of Plants" is a familiar title, allowing free play to an author's imagination: to the layman it suggests a clear picture of the gradual development of plant-life from a speck of living protoplasm to an oak tree. The nearer a book approaches to this standard of precision the less value it has for the biologist. Bernard's book is not of this class; it is a serious contribution which should at least bring home to the layman not only the difficulties of the problems discussed, but also the extent of our ignorance of the lines along which the development of the plant kingdom has proceeded. A. C. S.

Ambulance de "L'Océan," La Panne. Tome i., fasc. ii. Travaux publiés sous la direction du Dr. A. Depage. Secrétaires de la Rédaction: Dr. A. P. Dustin, Dr. G. Debaisieux. Pp. 381. (Paris: Masson et Cie, 1917.)

THE editor and publishers may be congratulated on the attractive way in which this second number of the "Travaux" of the "Ambulance de 'L'Océan'" at La Panne makes its appearance. The papers are copiously illustrated with beautifully executed figures. The researches are naturally devoted to questions concerning the pathology and treatment of wounds and contain many valuable results, which do not admit of a brief account. The following may be referred to as of more general scientific interest. Depage and Maloens show that wounds naturally tend to become sterile; the process, nevertheless, may be aided by the brief action of a strong antiseptic. But prolonged action is injurious to the growing cells. The good effect of Dakin's solution is said to be due chiefly to its solvent action on exudations and dead tissue. Dustin gives a valuable and complete account of the histological changes in injured nerves. De Harven concludes that the choroid plexuses have a secretory function. Sand brings evidence to show that toxic products are produced by the disintegration of injured muscular tissue, whether due to mechanical action or to bacterial infection. Levaditi and Debrez give a detailed investigation of the flora of wounds and of the physico-pathological properties of exudations. Zunz was unable to find "acidosis" (diminution of alkaline reserve) in the blood of wounded men, unless bacterial infection or respiratory obstruction was present. Govaerts points out the importance of transfusion of blood at an early stage after hæmorrhage. Saline solutions were found useless, but the effect of the addition of gum was not tested.

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.*]

Medusoid Bells.

JUST now the sea is full of little tiny bells, and, what is more, they are *all a-ringing.* A few weeks ago I watched some of them developing. Precisely how they do so is not very easy to see, but they develop with amazing rapidity. It is hard indeed to believe that they "grow," cell by cell; rather do they seem just to "come off" the parent stock, one after another, like little curiously formed drops or droplets. They seem to me to be formed *as a whole,* and, apparently (to use Adam Sedgwick's words, written more than thirty years ago), whatever cellular elements they contain "must be regarded as a multiplication of nuclei and a specialisation of tracts and vacuoles in a continuous mass of protoplasm." If this be so, we may throw conventional embryology aside, and conceive of the little bell as being automatically conformed by some physical process akin to the many beautiful phenomena of ordinary drops. But let us pass this problem by for the moment, and merely inquire what modifications of structure would be likely to ensue if the little bell, once formed or partly formed, were to be in a state of vibration; and if at the same time its semi-fluid or colloid and very heterogeneous substance were such as to permit easy transference from place to place of its heavier or lighter particles.

Suppose the little bell to vibrate as other bells do, then its fundamental note will give us four marginal nodes and four corresponding radial nodal lines. We see the latter marked out in our medusoid in the form of four equidistant and exquisitely symmetrical "radial canals"; while at the marginal nodes there appear little aggregations, sometimes of pigment, sometimes of calcareous matter, which we call "eye-spots" or "otoliths." The margin of the bell, if it be free and thin, will tend to be thrown into secondary vibrations, overtones of the fundamental note; and these, as the substance firms, are rendered visible as little rounded lobes and notches set round the bell with perfect symmetry. At the nodal points we may next anticipate that little portions or drops of quasi-superfluous fluid might accumulate, and these would gradually elongate into streamers or "liquid jets," and would vary in form, remaining single or becoming branched, remaining smooth or becoming annulated or beaded, according to the surface-tensions between their substance and the surrounding medium. In any case, they would agree in number and position with the nodes, and where these were numerous and of successive orders, so also would the tentacles tend to correspond in order and magnitude. In short, several of the most important and most conspicuous features of the little "bell" would follow from the simple hypothesis of its intrinsic vibration. Fitzgerald and others have suggested that we may, in like manner, ascribe to vibration the minute and exquisite patterns of many diatoms; Dendy and Nicholson have made use of the same hypothesis to explain the characteristic form of certain sponge-spicules. I have a strong idea that the principle is very far-reaching indeed, and that its bearing on morphological problems will be found to be of great importance.

Our little medusoid is but a single instance, a single type, out of very many. All through the Cœlenterata, in polypes and corals of all sorts, we are confronted by the phenomenon of geometrical symmetry, and corresponding numerical symmetry of parts in 4's, 6's, 8's, 12's, and so on. We are dealing with what look like vibration-phenomena, with their nodes and internodes; and that is just what I think they really are. Romanes, when he was studying the Medusæ, remarked that "the organism is constructed on what we may metaphorically [?] term a very definite plan"; that its organs had "a very precise geometrical relation" to one another, and that its radial canals were "disposed with perfect symmetry." These are indeed very remarkable features, and the vibration hypothesis seems fitted to account for them all.

What the motions are which the vibrations of the little bell set up in the surrounding fluid, and how these current or vortex movements may react upon the shape of the bell itself, is (I think) another chapter of the same story. D'ARCY W. THOMPSON.

The University, St. Andrews, July 31.

The Encouragement of Invention.

WHILST everyone, including our Government, expresses anxiety to encourage invention in this country, this same Government does what it can to stifle it by taxing royalties on patents as unearned income. If any income is earned, and dearly earned, I should say that it is that derived from patents.

SPENCER PICKERING.

THE EDUCATION BILL.

THE third reading of the Education Bill was agreed to by the House of Lords on Monday, August 5, and it is expected that the measure will receive the Royal assent during this week. The Bill passed through its second reading and Committee stages in the House of Lords without noteworthy changes. Lord Lytton moved the second reading on July 23, and represented the Board of Education during the Committee stage.

Lord Sydenham made a praiseworthy effort to secure the insertion of the words "including instruction in science" in sub-section 1 of the Bill, but unsuccessfully. He pointed out that it is remarkable that the word "science" does not appear in the Bill, and he rightly urged that in the twentieth century no educational measure is complete which overlooks the power of science and the influence of the scientific spirit. Cookery is mentioned in the Bill, yet Lord Lytton objected to the insertion of the words suggested by Lord Sydenham on the ground that reference should not be made to specific subjects of instruction. It was misleading for Lord Lytton to refer to science as an *item* in the curriculum, and to object to the inclusion of the word in the Bill on that account; for Lord Sydenham's amendment had as its intention not so much the prescription of a particular subject of study as the recognition of a prime factor of modern life.

Lord Crewe, leader of the Opposition, paid a high tribute to Mr. Fisher for the masterly way in which he had been able to satisfy so many of the educational needs of the country, and at the same time to commend his reforms both to the House of Commons and to the country. He regarded the concession of the postponement of compulsory continuation education in the case of children between sixteen and eighteen as mainly justified by the impossibility of obtaining the requisite supply of teachers, but was somewhat more doubtful about the reduction of the hours of attendance in continuation schools from 320 to 280.

In reply to some critical observations on the financial aspects of the Bill, Lord Lytton said it was not possible to give an accurate estimate of what the Bill would cost, but the largest item would be the expenditure on continuation schools. In England and Wales, with a population of 36,000,000, the expenditure on secondary and higher education is 6,500,000*l*. For the same purposes Prussia, with a population of 40,000,000, spends 10,000,000*l*., and in the United States, with a population of 91,000,000, the expenditure has risen from nearly 38,000,000*l*. in 1913 to 44,000,000*l*. in 1916. In view of these comparisons, Lord Lytton asked: Could we afford to neglect further provision for higher education? We spend 30,000,000*l*. on elementary education, and do not get the full benefit of the expenditure.

These comments by the Government spokesman for the Bill seem to be somewhat disingenuous, seeing that the Bill provides no guarantee of any sort of the much-needed development of higher education in the only real sense—that is, of persons *above* the age of eighteen. This is distinctly a blot on the Bill, the more noticeable because no undertaking has been given by Mr. Fisher that adequate provision will be made for the development of university education and the encouragement of scientific research. One result of the Bill is sure to be that rate-aid for education and the attention of local education authorities will be fully mortgaged for elementary and secondary education. It will, therefore, be incumbent upon the Government to provide a large part of the funds required for university education.

During the discussion of the Bill in the House of Lords, Lord Bryce expressed the view of an ancient corporation that the Board of Education should hold its hand before creating any more universities in this country. A more helpful suggestion would have been for the appointment of some impartial authority to examine the whole question of the provision of education of university type, and the facilities available to enable men and women to obtain a university education. On one hand, the war has shown that the country needs a much larger supply of highly trained men and women, and, on the other, it is common knowledge that thousands of qualified students are unable to afford a university education, the financial incidents of which will become much more difficult after the war. If the soldier in the trenches, who, by the qualities of courage and cheerful fortitude he has shown during the war, has satisfied the highest tests of education, is found to require further instruction, what would be the verdict in the case of our diplomats, Civil Servants, and Staff officers? It is to be hoped that Mr. Fisher, having achieved a great personal triumph in the passing into law of his Education Bill, will attack the problem of higher education with equal fervour and success.

SCIENCE AND THE CIVIL SERVICE.

THE great technical developments of the nineteenth century, which were due in a large measure to the influence and progress of science, have undoubtedly introduced not only a great transformation in the internal affairs of the country, but also an altered outlook in the external relations of the State. In consequence, many and extensive have been the changes gradually brought about, during the past century, in the duties and responsibilities of the Civil Service. Every Government Department has been affected to some extent; in some of them there have come into existence innovations which are of a very far-reaching character. The outstanding feature of this evolution is that the work of Government Departments has to-day entirely ceased to be of a purely administrative order, whether it be in relation to legislative measures referred thereto for preparation, revision, or criticism, or to the operations conducted therein, or to the sphere of human activity superintended, controlled, or managed thereby. The business of every Government Department is to-day to some extent technical or scientific; in the case of some Departments the administrative aspect predominates; in others it is the technical or scientific aspect that plays the more important *rôle*.

What, then, has the State done to ensure that the *personnel* of the Civil Service, through whom its responsibilities must be largely exercised, shall be properly qualified and equipped for dealing, under present-day conditions, with the social, industrial, and commercial problems which must come before it for legislative, executive, or other action?

One important step certainly has been taken in relation to this matter: it has been definitely laid down that candidates for the Civil Service shall, before appointment, be required to undergo some test as to their knowledge and capacity. To give effect to this decision the Civil Service Commission was, by an Order in Council dated May 21, 1855, appointed to organise a system of examination; the Commission continues to be charged to the present day with the duty of providing suitable candidates for the public services. In 1870 the principle of open competition was introduced for the purpose of filling certain specified situations in the Civil Service, without, however, entirely abolishing "patronage" appointments. Afterwards, in 1876, the clerical establishment of the Civil Service was divided into a higher and a lower division; in 1890 the name "lower division" was altered to "second division," and a provision introduced making it possible for a "second division" clerk to be promoted to a higher division clerkship. It is the clerical establishments of the Civil Service which have alone received attention in the foregoing legislation.

Obviously, it is on the complete success of the competitive examination scheme in force that the welfare of the Civil Service, and, therefore, the protection of the public interest, must depend. It is here that a serious failure has occurred; the open competitive scheme has not been an entire success; it has been productive of a very unfortunate result. The system of marking adopted in the examination favoured candidates whose education consisted largely in the learning of ancient Greece and Rome, and handicapped those whose *forte* was science.

Furthermore, in practically every case the officials who have in recent years received "patronage" appointments in the higher division of the Civil Service are men whose education and training have been identical in character with those of Civil Servants entering the Service by open competition. In consequence, at the present day the highest administrative posts in nearly every Department are monopolised by men whose learning is entirely literary. Further, the technical officers—that is, those in whose education science has played the preponderating *rôle*, and on whose skill and knowledge the welfare of many of the public services very largely depends—are almost entirely excluded from a share in the important administrative posts; needless to say, much to the injury of the public services.

Could it be shown that a purely classical or literary education really tends to develop or to produce administrative talent in an individual superior to that which can be obtained by means of a scientific education and technical training, as is sometimes claimed, there might indeed be some excuse for the retention of the principle of selection adopted; but there is none in actual fact. There exists, on the contrary, abundant evidence to prove conclusively that administrative talent is no exclusive privilege or quality of those who have received a purely classical or literary education: the names are familiar, in wide circles, to high and low, of men who have proved themselves capable administrators of the highest order; men, possessing the capacity of a Cromer or of a Kitchener, in whose education instruction in science also occupied a very prominent place; men whose early years were, too, spent in technical spheres.

The opinion has been gaining ground for some time past that the administrative system of Government Departments is unsatisfactory. The extracts from the reports of the Exchequer and Audit Department published from time to time, wherein publicity is given to the defects in the administrative arrangements in connection with the public services, have provided, in relation to such matters, authentic evidence tending to confirm, in the public mind, the unfavourable opinions that prevail so widely as to the unbusinesslike methods of the Civil Service and the general lack of capacity shown by a large majority of its members. Other authentic evidence is available—some recorded, some not; some public property, some not—which provides an indication that scientific knowledge and technical experience are held in disrepute in many, happily not in all, Government Departments; and, further, that the professional opinions of technical officers too frequently are not given the due weight which they deserve. Science has done much for the Civil Service; it has not, in return, received the recognition which it merits.

The question arises: How can the defects and abuses known to exist in the Civil Service be best corrected? Remedies there are, some of which have been made public. Such remedies are not competitive *inter se*: they can be applied concurrently, and are capable both of promoting the welfare of the Civil Service and at the same time of adequately protecting the public interest. The report of Sir J. J. Thomson's Committee on the position of natural science in the educational system of Great Britain (Cd. 9011) contains two important recommendations having these objects in view, viz. (*a*) that all candidates for the competitive examination for the Home and Indian Civil Services should supply evidence of a continuous training in science extending over several years; and (*b*) that many posts in the public services should be filled by men selected, not by the ordinary competitive examination, but, at a riper age, on the ground of high scientific qualifications and professional experience.

In view of the present organisation of the Civil Service, it is very certain that the adoption of the first of the foregoing recommendations alone, as a solitary and isolated measure of reform, will not cure the defects known to exist in the Service. The scheme will do little to provide the Civil Service with a sufficient number of men of high scientific attainments and proficient technical knowledge capable of administering the affairs of a modern State in the spirit of progressive knowledge; it will not remove the schism between the administrative and technical staffs of the same Department, a schism which, unfortunately, exists in some Departments to-day.

As regards the second of the above recommendations, presumably the intention is that the men of riper years selected on the ground of professional experience shall fill some of the high administrative posts in the higher division. If this is so, the recommendation is an admirable one and worthy of immediate adoption. But the question arises whether the State will provide remuneration at a rate high enough to secure for the public services men of sufficiently good abilities. Unless it does so, nothing will be gained by the adoption of the recommendation.

A Government pension under the special provisions contained in section iv. of the Superannuation Act, 1859 (22 Vict., c. 26)—*i.e.* one calculated at a higher rate than the ordinary scale—might possibly, in some instances, have been considered by candidates a sufficient compensation for the lower rates of salary prevailing in the Civil Service as compared with those paid by private employers and public corporations. But this feature of the Government pension scheme, provided originally to meet the cases of the kind now under consideration, has ceased to exist: the section of the Act of 1859 in question was repealed by section v. of the Superannuation Act, 1914 (4 & 5 Geo. V., c. 86).

The only effective remedy for curing the ills from which the Civil Service is suffering at the present time consists in a root-and-branch reform, a reform involving the re-fashioning of its entire framework and fabric. No dangerous or expensive experiments are necessary for the purpose of "trying out" and "proving in" a new organisation: a model well worthy of imitation exists in the Swedish Civil Service, with its administrative boards. This model could easily be adapted to meet the requirements of this country; the system of administrative boards would provide a means for utilising to the best advantage the existing administrative and technical officers in the Civil Service by associating with them men of large business and professional experience drawn from outside the public services. A reorganisation on the lines here suggested would naturally bring in its train the recognition of the necessity for a more widespread knowledge of science in the Civil Service. Simultaneously, effect could be given to the recommendation regarding the appointment, to permanent posts of the higher division, of men of professional experience as recommended by Sir J. J. Thomson's Committee. Finally, with the advent of the administrative boards would disappear the methods of administration based on the despot's maxim, *Divide et impera,* methods which continue to have a vogue in certain Departments. Such methods, it is scarcely necessary to point out, are extremely wasteful, and can have no place in any *régime* which relies for its prosperity and efficiency on science.

THE EARLY HISTORY OF THE SOLAR SYSTEM.

A COMMON feature of the older theories of the origin of the solar system is that they all suppose it to have been derived from a more or less symmetrical rotating nebula in a gaseous or quasi-gaseous state. By some process, the details of which differ in different theories, this mass is supposed to have condensed locally to form the sun and planets. A recent paper by Jeans has indicated a way of examining whether such condensation is possible. Viscosity is insufficient to cause a mass so large as the primitive nebula to rotate like a rigid body; each part would revolve practically independently around the centre under gravity, and the matter near any point, on account of the *differences* between the velocities of different parts, would be in a state of rotation with an angular velocity different from that of its revolution as a whole. It is, however, easily shown that the two are of the same order of magnitude. Now a mass cannot condense locally unless the density is so great that mutual gravitation is enough to balance the centrifugal force due to the rotation, and this indicates that, before condensation started at distance r from the centre, the density there must have been at least comparable with the mean density of a sphere of radius r and mass equal to that of the sun. Planets having been formed at many different distances from the sun, it follows that the mass must have originally been widely distributed through the system. The distribution of density and velocity being thus known within sufficiently narrow limits, it can be shown by the principle of the constancy of angular momentum that if planets of the sizes of ours were formed, the resulting central body could not possibly rotate so slowly as the actual sun. There is no agency capable of reducing this rotation, and it seems necessary to abandon completely those hypotheses that require the solar system to have been formed by the gradual condensation of a nebula.

We are led to inquire next whether planets could come into being by a more rapid or catastrophic process. Projection from the sun is not a possible origin, for a body started in this way must necessarily strike the sun again on its return and be reabsorbed; further, there is no reason why all should revolve in the same direction. The tidal theory appears to give a better account of the present state of the system. According to this, a star much more massive than the sun approached it very closely, and raised on opposite sides of it two projections, just as the moon raises tides in the earth; but the scale of the disturbance was in this case so enormous that the sun's gravitation was unable to prevent a rupture from occurring. Thus either one or two streams of matter were shot out in a time comparable with a few months or years. Being longitudinally unstable, they broke up into a series of detached masses, perhaps before the parts projected later had actually separated from the sun. That such rupture could occur has been proved by Jeans. The attraction of the disturbing body produced the direct revolution (in the same sense as the motion of the star relative to the sun); some of the revolving matter returned into the sun and gave it a direct rotation. The angular momentum thus acquired was, of course, derived from the transverse motion of the disturbing body relative to the sun.

The size of the deformed body has little influence on its chance of being broken up. Thus the detached masses might well have produced systems of satellites and developed direct rotations in the majority of cases, though complete uniformity could scarcely be expected on account of the number of complicating factors. The fission would cease when the star had receded a sufficient distance; thus the outer nuclei, being the first ejected, would produce most satellites. It seems possible also that some of these would be formed when the nucleus and the sun were on opposite sides of the star, and that the motion would therefore be retrograde. All the bodies, having recently formed part of the sun, would naturally be very hot.

The system after the passage of the star would therefore include a central sun surrounded by a number of heated planets, moving in direct orbits, and attended by satellites; the most remote planets would have most satellites. The rotation of the sun would be direct; the rotation of each planet would be in the same sense as the revolution of most of its satellites, and in most cases this also would be direct, though a few exceptions might well occur, especially in the outermost sub-systems. In every point this agrees with the existing solar system. The heated interior of the earth, the building of mountains by compression, and the present heated state of the greater planets are readily accounted for. The occurrence of three retrograde satellites on the outskirts of otherwise direct sub-systems presents a difficulty, but not, I think, a serious one.

In addition to the planets and satellites, however, there would be a considerable amount of gaseous matter too light to be condensed into the nuclei, and probably consisting mainly of hydrogen. This would be pushed round by the planets as they moved, but its resistance to oscillatory motions would steadily reduce the eccentricities of their orbits, which would initially be considerable. At the same time its own viscosity and diffusion would cause it partly to dissipate into outer space and partly to be reabsorbed into the sun. The zodiacal light is probably the last remnant of it. The actual eccentricities of the planetary orbits being now small, but definitely different from zero, it seems that the time the medium took to degenerate and the time needed to produce a considerable effect on the eccentricities must have been of the same order of magnitude. These are capable of being estimated in terms of the density of the medium, the first being proportional and the second inversely proportional to it. Thus the condition that they are of the same order of magnitude makes it possible to estimate very roughly both the density and the time needed for the changes, which is found to be of the order of 3×10^9 years, as nearly equal as could be expected to the age of the earth indicated by its radio-active constituents (about $1{\cdot}6 \times 10^9$ years). At the same time large condensations would form around the larger planets, and the resistances offered by these would be so great, being proportional to the squares of the masses, that their eccentricities would diminish rapidly. Thus it would be expected that, on the whole, the larger planets would have smaller eccentricities than the smaller ones; this is the case, Mercury and Mars having larger eccentricities than Jupiter, Saturn, and Uranus, and the earth than Neptune. Venus has a somewhat smaller eccentricity than Neptune, but otherwise the agreement is remarkable.

It is certain that on the tidal theory the primitive nuclei must have been very hot, and probably fluid. Whether the larger ones were liquid or gaseous is very doubtful, but the smaller ones, including the asteroids and most of the satellites, can be shown to possess too little gravitative power to have been able to hold together in the gaseous state, and must therefore have been liquid or solid at the start. The satellites probably liquefied almost as soon as they were expelled from their primaries or from the sun, on account of the reduction in temperature caused by the release of pressure; solidification would occur more slowly. The origin of the asteroids presents greater difficulties. They may have started as independent planets of exceptionally small size; but the fact that none of their mean distances is greater than that of Jupiter, and only one is less than that of Mars, indicates a closer relationship between their origins. Several possible explanations can be advanced; the writer inclines to the belief that they were formed by the close approach of a primitive planet to Jupiter, leading to tidal disruption.

The large size of the moon relative to the earth suggests a fundamental difference of origin between it and the other satellites. It seems likely (indeed, on the theory of a formerly heated earth it is almost certain) that it was once much nearer the earth than it is now, and has receded on account of the friction of the lunar tides. It is natural to think that just before this state of motion with a comparatively small separation between their surfaces the earth and moon formed one body. The rotation would then be so rapid that the longest free period of the mass was nearly equal to the period of the semi-diurnal solar tide, which was consequently enormously magnified by resonance; and it is highly probable that the deformation became so great that the mass separated into two parts. This is not the only conceivable origin of the moon that would be consistent with the tidal theory; but several peculiarities in our sub-system suggest that it is the most likely. No other satellite in the system can have been formed in this way.

As has just been remarked, lunar tidal friction has probably been the predominant cause in the evolution of the earth and moon. No other satellite can raise tides of such importance; but those raised in Mercury by the sun must have been much more effective in reducing the rotation of this planet. Now from the fact that Mercury has no satellite we may infer that it never rotated so fast as the earth did before the moon was formed; and therefore the solar tides will have been able to reduce its rotation so as to make it always keep the same face towards the sun, which again agrees with observation.

Every satellite except the moon has probably been more influenced in its orbital motion by the resisting medium than by tidal friction. The most striking effect of the medium being to reduce the eccentricities of orbits, this accounts for the almost perfect circularity of the orbits of most satellites, especially those nearest their primaries, where the density of the medium was probably greatest. The effect of tidal friction on the eccentricities is not certain, depending on certain unknown physical quantities.

It may be said finally that at every point where the tidal hypothesis has been tested it agrees with dynamical theory and with observation. Several facts otherwise unaccounted for are explained by it, and nothing has yet been discovered to be definitely opposed to it, though a few difficulties, such as the origin of comets and meteor swarms, still remain.

REFERENCES.

J. H. Jeans: "The Part Played by Rotation in Cosmic Evolution," Monthly Notices of Royal Astronomical Society, vol. lxxvii., 1917, pp. 186–99; "Note on the Action of Viscosity in Gaseous and Nebular Masses," *loc. cit.*, pp. 200–4; "The Motion of Tidally Distorted Masses, with Special Reference to Theories of Cosmogony," Memoirs of R.A.S., vol. lxii., 1917, pp. 1–48.

Harold Jeffreys: "The Resonance Theory of the Origin of the Moon," Monthly Notices, vol. lxxviii., 1917, pp. 116–31; "On the Early History of the Solar System," *loc. cit.*, pp. 424–41.

HAROLD JEFFREYS.

GRASSLAND AND FOOD SUPPLIES.

THE persistent criticism with which the "ploughing-out policy" of the Board of Agriculture has been assailed has been intensified of late with the evidence of failure, total or partial, of some of the crops grown this year on newly ploughed grass land. The columns of the daily Press have been freely used, and have revealed much division of opinion amongst practical agriculturists as to the measure of success or failure in different areas. A new note has been introduced into the discussion by a letter from the Duke of Marlborough in the *Times* of July 30, in which he endeavours to demonstrate from the publications of the Board that the policy is fundamentally unsound.

Basing his criticism upon a leaflet issued by the Board in the spring of last year, his Grace argues that, so far from the data there given proving that an increase of food supply can be expected from the ploughing-up of grass and growing corn, they demonstrate rather that the chances of securing such an increase are very speculative and scarcely likely to be realised. The facts are not disclosed that the leaflet in question deals with the production of winter food for cows, and therefore only indirectly for the human population; and, further, that the dairy farmer is advised that a much greater return of milk-producing food can be expected from growing root crops rather than corn.

The basis of comparison of the feeding values of the crops adopted in the leaflet is quite inapplicable to the assessment of the relative returns for human feeding, since for the latter purpose grass is worthless until converted into other forms which represent only a fraction of the weight of grass harvested, whereas the corn crops, by the simple and expeditious process of milling, yield anything from 60 per cent. upwards of the weight of the grain in a form directly usable for human consumption, whilst, in addition, the accompanying straw, according to its nature, when used for food production purposes, will be roughly equal to one-half its weight of hay. The Duke of Marlborough anticipates this objection by pointing out that, so far as the oat crop, at any rate, is concerned, only a small proportion of it has, in actual fact, been directly utilised for human consumption. That is doubtless true, but the simple fact remains that throughout the anxious days of the food crisis, thanks to the patriotism and courage of the many farmers who voluntarily broke up grass last year, the nation possessed in reserve this valuable store of food available, if required, at short notice, and through the enterprise of the Food Production Department of the Board of Agriculture can face any future emergency with still greater confidence. Individual farmers who secure less than an average crop of corn may suffer loss on this year's crop, but there will be few cases in which subsequent crops, drawing upon the fertility accumulated in the soil throughout the many years under grass, will not satisfactorily redeem any present loss.

NOTES.

The important question of supplementing supplies of mineral oil by the distillation of cannel coal and allied bituminous minerals has been recently investigated by two separate committees. Whilst the possible production from home sources can amount to but a fraction of the total requirements of motor-spirit, fuel-oil, etc., yet such quantity as might be furnished by the raw materials which are available would undoubtedly tell appreciably in reduction of the tonnage at present required for the importation of oil. That large quantities of oil can be obtained from such material cannot be questioned, but with the reduction in labour, particularly at the mines, and with other demands for constructive material which would be required for the erection of retorts and refineries, the problem of utilising these sources must be dependent on the most economical use of available labour and material under existing conditions. The Government Committee presided over by Lord Crewe considers that a largely increased production cannot be obtained without interfering with other not less important industries (Cd. 9198). The Committee appointed last February by the Institution of Petroleum Technologists has considered the question as an immediate war measure, and as a permanent commercial undertaking and a measure of reconstruction, and in an interim report urges the War Cabinet to lay down a definite policy as to the relative national value of coal and oil, and the provision of the necessary labour, raw materials, and transport; to grant facilities for the erection at suitable centres of plant to those who are prepared to find the capital; to establish at once an experimental station where retorts to a design provisionally approved by the institution may be tested, or, failing such a Government station, to grant all necessary and reasonable facilities to the institution for erecting a station of its own. Whilst present conditions may determine that operations on a commercial scale are not immediately justified, there can be little question as to the economic soundness of such experimental investigations as are required to establish an oil industry as a measure of reconstruction which would be wholly beneficial to the nation.

In a recent letter to the *Times* Mr. W. J. Malden raises again the old question whether science has done or can do anything for the farmer. The occasion of the letter was Mr. Prothero's speech in the House of Commons containing a tribute to the work of Prof. Biffen on the breeding of wheat—a tribute which most people would think was well deserved. Mr. Malden objects on the ground that "there is nothing new of far-reaching value that the man of science can place in the hands of the farmer at this moment. . . . All that has been done by those practising Mendelism is puny as compared with what Garton and Findlay have done." But no Government Department proclaims their work, and no honours are bestowed on them. The claim would scarcely be worth rebutting did it not represent the attitude of some of the less informed farmers, who hold that there is nothing new under the sun, and that science in particular can teach them nothing. This opinion was at one time fairly common, but it has been steadily dying out during the present generation. In an ancient and highly individualised industry like farming there has been such an enormous variety of practices that, if one goes far enough back over a sufficiently wide field, it is possible to find anticipations of most of the modern improvements. It would be disingenuous to argue, however, that farmers have known these things for generations. It is true that Messrs. Garton and Findlay have improved crops. But they have made no additions to our knowledge; they have kept their secrets to themselves, and no one can practise or develop their methods. It is untrue that their work has remained unrecognised; the community has paid them handsomely for their products. The man of science does not keep his secret to himself, but gives it to the world so that others may benefit thereby; he makes no fortune, and Mr. Malden and those who think similarly should not begrudge him such meagre recognition as he obtains. In the early days of artificial manures it was not uncommon for certain writers to maintain that these substances, being new, could not possibly be useful. Yet the scientific investigator persisted, and to-day the use of artificials is a regular feature of husbandry. We do not wish to fall into the opposite error and overlook the enormous help rendered to agriculture by business men. We must, however, point out that the man of science not only provides a new appliance, but also teaches how and why to use it; all experience shows that intelligent men claim to know why they should do a particular thing in a particular way. This science alone can teach.

The death is announced, at fifty-two years of age, of Dr. F. E. Batten, physician to the National Hospital for the Paralysed and Epileptic, London, and distinguished by his scientific work in neurology.

The Conrad Malte-Brun prize of the French Geological Society has been awarded to Prof. L. Martin, of the University of Wisconsin, for his researches on the glaciers of Alaska.

Prof. Theodore W. Richards, of the Wolcott Gibbs Memorial Laboratory at Harvard University, has been elected a foreign member of the Accademia dei Lincei, Rome.

The exploration of the cave known as "Ghar Dalam," Malta, referred to by Prof. A. Keith in Nature of July 25, p. 404, has been assured for the present year. Besides the sum of 50*l*. given by Sir Thomas Wrightson, Bart., Dr. Robert Mond has placed 50*l*., and Dr. Charles Singer 10*l*., at the disposal of the committee in charge of operations.

It is stated in the *British Medical Journal* that the National Medical Institute of Mexico, which was founded in 1890 for research on the flora, fauna, climatology, and geography of Mexico, and for the exploitation of these resources, has by a recent decree been transformed into the Institute of General and Medical Biology.

We learn from the *Times* that a special general meeting of the Royal Society was called for Wednesday, July 31, to consider the following motion submitted by Sir George Beilby and Dr. M. O. Forster:—"That, in view of the war having continued during nearly four years without any indication that the scientific men of Germany are unsympathetic towards the abominable malpractices of their Government and their fellow-countrymen, and having regard to the representative character of the Royal Society among British scientific bodies, as recognised by the patronage of his Majesty the King, the council forthwith take steps necessary for removing all enemy aliens from the foreign membership of the society." The council of the society has had the matter under consideration, and decided to refer the question of expulsion to a conference of representatives of Allied academies to be held in October next. This decision was approved by the meeting, which adopted the following resolution:—"That the delegates of the Royal Society at the forthcoming conference with the representatives of the academies of Allied countries should raise the question of the expulsion of enemy foreign members, with the view of eliciting the opinion of the conference as to the desirability of joint action, and that the subject be reconsidered at a future meeting of the society on the report of the delegates."

THE Board of Agriculture and Fisheries has appointed a Committee to study the life-habits of the honey-bee with the object of improving the conditions under which bee-keeping is carried on in England and Wales, and to investigate the epidemic diseases of the bee, more especially the disease or group of diseases which pass under the name of "Isle of Wight disease." The Committee consists of the Master of Christ's College, Cambridge University (Dr. A. E. Shipley, F.R.S.), Prof. R. C. Punnett, F.R.S. (professor of genetics, Cambridge University), Dr. G. S. Graham Smith, Prof. G. C. Bourne, F.R.S. (professor of zoology and comparative anatomy, Oxford University), Prof. W. Somerville (professor of rural economy, Oxford University), Mr. T. W. Cowan (chairman of the British Bee-keepers' Association), Mr. G. W. Bullamore, Mr. J. C. Bee Mason, and Mr. A. G. L. Rogers (head of the Horticulture Branch, Board of Agriculture and Fisheries). Mr. R. H. Adie will act as secretary. It is proposed to undertake the study of healthy bees at Cambridge and the investigations on "Isle of Wight disease" at Oxford. The Committee will be glad to receive specimens of bees suspected of suffering from "Isle of Wight disease" for examination and experiment. Communications on this subject should be addressed to Mr. Rogers at 4 Whitehall Place, London, S.W.1.

JULY this year stands out meteorologically as wet and rather cool. The especial feature was the heavy rainfall, which was essentially of a thunderstorm type. At Greenwich the aggregate rainfall for the month was 7·37 in., which, according to the series of observations from 1815, is the wettest July on record, and there has only been one wetter month at any time of the year, October, 1880, with 7·65 in. The excess of rain at Greenwich is 5·32 in. In the week ending July 13 the rainfall was 2·48 in., and on the two days, July 11 and 17, in thunderstorm rains, the total measurement at Greenwich was 3·03 in., whilst at Camden Square the rainfall for the same two days was 0·99 in. and at Kew 1·07 in. At Tulse Hill the total rain for July was 7·62 in., and at Wandsworth Common 7·16 in., whilst at Kew the fall was only 4·65 in., and at Camden Square 4·92 in. The weekly weather reports published by the Meteorological Office show that July was wet over nearly the whole of the British Isles, there being an excess of rain in all districts except in Ireland N. The data for the four weeks ending July 27 practically give the rainfall for the whole of July, as the closing days of the month were fine. The wettest district was Scotland N., where the measurement was 4·54 in., and it was 4·50 in. in Scotland E.; the wettest district in England was the S.E., with 4·43 in. The driest district was Ireland N., where the measurement was 2·81 in. Very little rain fell during the opening week, and in many parts of England the period was rainless. The mean temperature at Greenwich was 62·4°, which is 0·4° below the normal, and the absolute highest temperature was 82°. Over the British Isles generally the greatest deficiency of temperature occurred in the second week, ending July 13, when in parts the deficiency was from 3° to 4° F. Sunshine was not very different from the normal.

PROF. P. D. HAHN, whose death at the age of sixty-nine occurred on March 9, had occupied the chair of chemistry at the South African College, Capetown, since 1876. He was a South African by birth, the son of a German missionary stationed in Great Namaqualand. He received his early education in Germany, whither his parents had returned during his infancy. After graduating at Halle he studied in London and Edinburgh, eventually returning to Capetown in 1875. Throughout his career Prof. Hahn manifested a keen interest in the agricultural progress of South Africa; he helped in the establishment of an Agricultural Department for Cape Colony, and the recent institution of faculties of agriculture at Pretoria and Stellenbosch Colleges was an outcome of his advice. He had broad scientific sympathies, however, and urged upon the authorities the need for providing scientific instruction in mining and other subjects, as well as in agriculture. The present School of Mines and Technology at Johannesburg has grown out of the scheme which was devised as the result of his representations to this end, and it was on his recommendation that Government chemical laboratories were established in Capetown. Prof. Hahn was twice president of the Cape Chemical Society, and was also president in 1911 of the South African Association for the Advancement of Science. He had been a member of the council of the Cape of Good Hope University for forty-two years.

M. CHARLES JOSEPH ETIENNE WOLF died at Saint-Servan on July 4 at the age of ninety. He was born at Vorges, near Laon, being an Alsatian by descent. He was appointed professor of physics at Nîmes in 1851, afterwards in succession at Metz and Montpellier; he made pioneer researches at Montpellier, in company with M. Diacon, on the temperature changes in the spectra of metallic vapours. In 1862 he accepted Le Verrier's offer of an important post at the Paris Observatory; the great meridian circle and other new instruments had just been installed, and he took a large part in superintending the scheme of observations, paying special attention to the personal equation. He designed an instrument for its investigation, which was adopted in many observatories. Later he introduced a system of synchronised clocks, first in the observatory, afterwards throughout Paris. M. Wolf made, in conjunction with M. Rayet, the important discovery of the Wolf-Rayet stars with bright-line spectra, which play a large part in theories of cosmogony, a subject on which he was himself a fruitful writer. He investigated the proper motions of stars in clusters, especially in the Pleiades and Præsepe. He took a large part in preparing for the transits of Venus, investigating the Black Drop, etc. His old age was occupied with writing historical memoirs on the former standards of length, on those of the metric system, and on the Paris Observatory. He retired to Vorges, his birthplace, where he delighted to welcome the descendants of his only daughter. In 1914 the German invasion obliged him to leave his home, and he moved to Saint-Servan, where he died. M. Wolf was elected a member of the Paris Academy of Sciences in 1883, and was its president in 1898. He was elected an associate of the Royal Astronomical Society in 1874.

MR. J. REID MOIR describes in *Man* for July a floor recently discovered at Ipswich containing some implements of the Early Mousterian period. A full account of the stratification of the site is given, with drawings of the implements discovered in the course of the excavation. It is at present somewhat difficult to correlate this discovery with that of the Aurignacian floors previously examined in the same neighbourhood, but further research may render this possible. The bones found are identified by Prof. A. Keith as those of an elephant, reindeer, ox (*Bos primigenius*), and goose, many of them showing splitting for the extraction of the marrow

IN the current issue of *Folklore* (vol. xxix., No. 2) Mr. W. Crooke contributes a paper on "The Home in India from the Point of View of Sociology and Folklore." The evolution of the form of the house, which in Western societies is often obscure, can be effectively examined among the castes and races of the Indian Empire, more or less completely isolated by distinctions of race and belief. The various forms assumed by the houses in India are fully described. One of the most primitive is that of the round house, of which there are some survivals, often in the form of churches in Europe, derived from the habit of bending down the pliant branches of some tree like the bamboo to form a temporary shelter. This also accounts for the curvilinear form of the Buddhist stupa, or receptacle for relics. The great pillared halls of the Mogul palaces are similarly derived from the reception pavilions of Central Asia. The occupation of a house marking a crisis in social life, a *rite de passage*, as Continental anthropologists describe it, gives rise to numerous taboos and precautions in order to disperse the evil spirits which occupy the site. The site selection, the laying of the foundation-stone, and the erection of the roof-beams are in the same way regulated by elaborate ceremonies. One curious phase is when a man, acting as a "scape-goat," is sent into the house before the owners occupy it, in order to take on himself the dangers to which they would otherwise be exposed.

THE question of the preservation of paper in India has recently been discussed at the All-India Conference of Librarians at Lahore. Mr. W. Railt, the cellulose expert, who read a paper on the subject, remarked that the problem was not new in England, America, or Germany. But these investigations have little applicability to the problem in tropical climates. Sir Aurel Stein found paper produced from linen or cotton rags in Central Asia in the fifth or sixth century A.D. still fresh and crisp. Complaints of the deterioriation of paper in India date from the introduction of rag substitutes after 1860. Within the next fifty years most of the reports and documents for which such paper was used will, he believes, be unreadable, while those of an earlier era will be quite sound. This is a very serious statement, and the conference passed a resolution advising the Government to undertake an inquiry into the whole subject, and impressing on them the urgent necessity of securing a supply of paper capable of permanent preservation for all records of permanent value. Mr. Chapman, of the Imperial Library, Calcutta, remarked in the course of the discussion that he had made a list of books in that institution published between about 1790 and 1870 the paper of which had perished badly. This list was sent to the British Museum, and the authorities reported that their copies of these books were in perfect condition. The factor of climate is therefore of great importance in the case of books printed on paper made of rags and forms of cellulose.

IN the *Revue Scientifique* for June 8 MM. Sartory and Blaque review the bacteriology of war-wounds. A large proportion of these are infected with various species of bacteria, because the fragments of the projectiles, principally shrapnel, are soiled with earth, and may also carry into the wound fragments of clothing likewise soiled with earth. From about the ninth hour after infliction the microbes that have gained access begin to multiply in the wound, in particular certain anaerobes, such as the *Bacillus perfringens* group and the organism of malignant œdema, which are concerned in the production of gas-gangrene. Then the *Bacillus coli* begins to grow, and by about the twentieth hour streptococci and staphylococci appear, associated with numbers of saprophytic bacteria. Supposing that the patient survives and gas-gangrene does not occur, the wound becomes an ordinary suppurating one from the seventh to the twentieth day. At this stage the anaerobes disappear and the pus-producing organisms become paramount—cocci, *Bacillus coli*, *B. proteus*, and *B. pyocyaneus*.

DR. JAMES RITCHIE, in the *Scottish Naturalist* for June, records the occurrence of a giant squid (Architeuthis) stranded in the neighbourhood of Skateraw, on the eastern coast of Haddingtonshire, on November 2, 1917. The body had suffered mutilation at the hands of the curious before Dr. Ritchie arrived on the scene, but he was enabled to obtain important notes and measurements, which he records at length in his communication. The body, from the tip of the tail to the base of the tentacles, measured 5 ft. 9 in.; while the stalked arms measured 14 ft. Unfortunately the beak had been removed, as also had the pen, though portions of this were found on the beach. The eyes also were missing, a fact which is the more regrettable, since these afford valuable specific characters. From a careful study of these remains the author is of opinion that this squid may be identified as *Architeuthis harveyi* of Verrill, and marks the only definite occurrence of a giant squid on the coast of Great Britain.

TWO valuable papers, on the morphology of the vertebræ of the Temnospondyli and Stegocephalia, and on the osteology of some American vertebrates, by Mr. S. Williston appear in Contributions from the Walker Museum, Chicago (vol. ii., No. 4). The author remarks that while no material differences are apparent between the skulls of Edaphosaurus and Naosaurus, or between the parts of the appendicular skeleton, yet there exist well-marked differences in the spines of the cervical vertebræ, since in Naosaurus these are broadly dilated and thickened at the extremity, while in Edaphosaurus they are slender and pointed. The author is fortunate in being able, for the first time, to describe and figure the complete skull of Naosaurus, inasmuch as this has enabled him to set at rest some doubtful points in regard to this genus and its allies. Finally, the author describes a new genus and species of the Diplocaulidæ. The remains on which the new genus is founded were obtained in the Craddock bone-bed, near Seymour, Texas.

THE recently issued Bulletin of the Imperial Institute (vol. xv., No. 4) contains several papers of economic importance. Among them may be mentioned a useful article on the peas and beans of commerce, and another on the various useful fibres of the Belgian Congo. In view, however, of the world's demand for oils and fats for the manufacture of margarine, the article on the oil-seed industry of Rhodesia is worthy of more particular attention. It seems probable that the cultivation of oil-seeds may become an important industry in Rhodesia. Ground-nuts and sunflower-seeds are the only oil-seeds produced commercially at present, but experiments conducted at the agricultural stations indicate that success may attend the cultivation of other oil-seeds. Castor-seed, sesame, and linseed have recently been sent from the Government gardens, North Rhodesia, to the Imperial Institute, as well as sunflower, and have been found to be entirely satisfactory. Before the war sesame-seed was chiefly crushed on the Continent, and the inclusion of its oil in margarine was compulsory. This, on the outbreak of the war, naturally raised the price of sesame oil considerably, and cheaper and equally good oils were adopted as substitutes. If, however, the Rhodesian sesame-seed can be successfully grown and the oil be procured in this country at a cheap rate, the industry may well have an important future before it, for sesame-seed is now being crushed in this country, and the Rhodesian seed will be a valuable addition to the available supply of seed.

According to the *Revue générale de l'Electricité*, a Dutch company has taken out French Patent No. 480,857 for a thermic telephone, in which the strength of reproduction of the voice may be regulated as required. The result is obtained by giving the instrument the form of groups of thermal conductors, superposed or placed side by side in the same box, and mounted on removable supports and conductively joined to each other, so that the number can be chosen according to the requirement of the person using the telephone.

French Patent No. 483,519 describes an incandescent electric lamp with spiral filament capable of giving a concentrated beam of light and high candle-power. This is effected (*Revue générale de l'Electricité*, April 20) by using a projecting mirror cooled by the continuous circulation of water or air between the walls of which it is formed. The mirror is placed inside the bulb of the lamp. The cooling water may be passed through coils, and it helps at the same time to cool the gas and increase its circulation in the bulb. Thus it is possible to raise the temperature of the filament and so obtain a greater candle-power and efficiency.

Occasionally an alloy of two or more metals which is known to possess good elastic properties will, for some unknown reason, fail under a stress much below its normal breaking stress. The cause of such failures in the case of brasses of the Muntz metal type has been investigated by Messrs. P. D. Merica and L. W. Schad, of the Bureau of Standards, whose work on the subject forms Scientific Paper 321 of the Bureau. As brasses of the type considered consist of solid solutions of α and β brass in each other, the authors have measured the rates of expansion with rise of temperature of the two constituent brasses. They find that while α brass expands at a nearly uniform rate from 100° C. to 600° C., β brass only expands at the same rate over the range 100° C. to 300° C., then at a considerably greater rate to 500° C., after which it again agrees with the α brass. From this it follows that when a brass containing both constituents is rapidly cooled over the range 500° C. to 300° C., stresses will be set up at the surfaces of contact of the two constituents, and in one case the decrease of strength of a specimen treated in this way amounted to 2000 lb. per sq. in. The authors state that other alloys are to be investigated, and the results will be awaited with much interest.

At one time there were a good many three-cylinder locomotives in this country, but they were all of the compound type. Mr. H. N. Gresley, of the Great Northern Railway, has brought out a three-cylinder high-pressure engine operated by two valve gears, and a description of this locomotive will be found in the *Engineer* for July 26. The engine, which is an eight-coupled coal locomotive, has been at work for some time, and appears to be fulfilling all expectations. Charts taken on a dynamometer car show that the engine starts much more easily than a corresponding two-cylinder engine, and owing to its more uniform turning moment the draw-bar pull is exceptionally steady. At present this engine forms a class by itself, but after the war is over it is probable that others of the same type will be constructed.

Some methods of reclamation of industrial waste products are described in an article in the *Times Engineering Supplement* for July. In some cases metal cuttings and scrap from machine tools have been subjected to treatment for the recovery of the oil used in cutting prior to disposal of the scrap to metal refiners. One case is cited of a prominent motor-car manufacturing firm recovering 1200 gallons of cutting oil per week, the oil being used over and over again on similar work, while the fresh oil necessary to make up for wastage amounted to only 10 per cent. of the total required. A turbine-centrifugal separator is used, with steam, for the dual purpose of propellant and liquefier. The oil contained in cotton-waste and cloths used for cleaning machinery, mopping up oil, etc., deserves more consideration than it usually receives. In numerous cases such materials, thrown away after first use, are of greater value than new materials. In an installation of the most complete type the dirty material is first passed through a turbine separator in order to extract the oil, which is ready for use again after purification. If the material has been used on comparatively clean work, it is ready for re-use as it comes from the separator; otherwise it is advisable to wash it in a machine resembling the ordinary laundry machine, and then partially to dry it in a hydro-extractor prior to final drying in cabinets or automatic rotary machines. With such a plant, turning out six tons of clean, dry rags per week and involving a capital expenditure of 2200*l.*, a saving of about 450*l.* has been effected in three months' working. Sixty-seven tons of rags and 4080 gallons of oil were reclaimed in this period, and the reclaimed oil was used as fuel for Diesel engines.

The twelfth annual report of the Executive Committee of the British Science Guild, just issued, contains a special reference to the aims and objects of the British Scientific Products Exhibition, to be opened next week at King's College, London. A series of interesting memoranda issued by the Education Committee is also included, dealing respectively with the Education (No. 2) Bill, scholarships for higher education, and the teaching of science. In a report on the introduction of the metric system, which was recently brought before the Ministry of Reconstruction, some concrete suggestions to facilitate legislative compulsion are made. Importance is attached to the adoption of metric measures in Government publications inviting tenders, etc., and their general introduction in schools and colleges. A report on the British dyes industry directs attention to the very large capital employed for this purpose in Germany and to the need for a complete statistical survey of the present condition of the industry in this country, with the view of preventing overlapping of effort. A full account is given of the addresses delivered by Lord Sydenham, Sir Algernon Firth, and Sir Henry Newbolt at the annual meeting on June 19. The offices of the Guild are at 199 Piccadilly, London, W.1.

Mr. Bernard Quaritch, having acquired the stock of "Biologia Centrali-Americana" from Dr. F. Du Cane Godman, is offering the work, either complete or in separate sections, at reduced prices. A prospectus explaining the origin and development of the "Biologia Centrali-Americana," and giving particulars of the contents of each of the sixty-three volumes, has been prepared by Mr. Quaritch, and will be sent to readers of Nature upon application being made for it to 11 Grafton Street, New Bond Street, W.1.

OUR ASTRONOMICAL COLUMN.

The Perseid Meteoric Shower.—The maximum of this brilliant annual meteoric shower will probably occur on Sunday night, August 11, and the best period for observation may be expected after midnight. The first traces of the shower were recognised on July 8 by Mrs. Fiammetta Wilson at Totteridge and by Miss A. Grace Cook at Stowmarket. A meteor was mutually recorded by them on that date and found to be a true Perseid, with a radiant point at $8^\circ+49^\circ$. Another member of the stream was seen by the same observers on July 12, and the activity of the display has been increasing nightly. On August 5, at 13.54 G.M.T., a splendid Perseid brighter than Venus was seen by Mr. Denning at Bristol traversing a path from $269^\circ+84\frac{1}{2}^\circ$ to $230^\circ+65^\circ$. With suitable weather there should be a rich display of Perseids this year.

Radial Velocity of β Canis Majoris.—In 1908 the star β Canis Majoris, of magnitude 2.0 and type B1, was found by Albrecht to be a spectroscopic binary with the very short period of about six hours. A further study of the star has recently been made by Dr. F. Henroteau, in which special efforts were made to secure continuous series of plates during the same revolutions (Lick Obs. Bull., No. 311). The mean velocity, of $+35$ km. per second, appears to be constant, but the range of velocity has been found to vary very considerably from one period to another, being sometimes as low as 3 km., and at other times as much as 18 km. per second. This variation in range shows no simple periodicity, but does not seem to be a discontinuous function. It is remarkable that while there is no period which connects and represents the different minima of velocities, a period of 0.25714 day, starting from a given maximum, always corresponds with either a maximum or a minimum of the velocity curve. It has been further noted that the spectral lines undergo a periodic change in width, the amplitude being always approximately the same, and the period 0.25130 day. This variation seems more likely to be due to physical changes in a single body than to the combination of two spectra, but no satisfactory explanation of all the peculiarities of the star has yet been found. Adopting Mitchell's parallax of $+0.009''$, the star would be about 1000 times as bright as the sun.

Relativity.—A paper by Jun Ishiwara on relativity (Proceedings of the Tokyo Mathematico-Physical Society, second series, vol. ix., No. 16, May, 1918) is based on the assumption that the gravitation potential is completely represented by a scalar quantity ψ; the components g_{hk} of the fundamental tensor of the time-space transformation and the scalar c (velocity of light *in vacuo*) are functions of ψ. It follows that the field-intensity is given by the gradient of ψ in space. The expressions for g_{hk} and c in terms of ψ are found with the aid of Poisson's equation, and the author deduces in an independent manner the same expression for the advance of the perihelion of a planet during one revolution as that already given by Gerber and Einstein, which is known to agree with the observed value in the case of Mercury.

Dr. L. Silberstein demonstrates in Monthly Notices of R.A.S. (May, 1918) that an unexpected consequence of Einstein's theory is that all homogeneous bodies must be spherical; he considered that this was a strong argument against the truth of Einstein's views. Prof. Eddington, in the discussion which followed, remarked that the principal bodies known to us in space do, in fact, approach very closely to the spherical form, and, further, that a perfectly homogeneous body is difficult to conceive, since there must be some differences of pressure, and therefore of density, in different portions of it.

THE SUPPRESSION OF BODY-VERMIN.

A comprehensive paper entitled "Combating Lousiness among Soldiers and Civilians," by Prof. G. H. L. Nuttall, appears in *Parasitology* for May (vol. x., No. 4). The paper is one of a series which, when complete, will constitute an exhaustive monograph on human lice. It brings together, not only the available published information, but also that resulting from hitherto unpublished research work, partly the author's own, and partly that of others contained in reports to the War Office, which he has been permitted to use. Prof. Nuttall has generously presented a special edition of three hundred copies of the paper to the Allied Armies; and, in view of the recently established fact that trench fever is conveyed by lice, this should prove a very timely gift.

The paper comprises 176 pages, with four plates and twenty-six figures in the text. Most of the pages are devoted to the practical consideration of louse destruction, a great deal of the experimental evidence being given in detail. The results obtained demonstrate that nits are killed by dry heat at 65°–70° C. in one minute, and at 55°–61° C. in ten minutes, the active stages being killed by dry heat at 65°–70° C. in one minute and at 55° C. in five minutes. After allowing for a margin of safety in practice, immersion in hot water at 70° C. for a minute or two is amply sufficient to destroy lice, while 55° C. for ten minutes is equally effective, a point of great importance in relation to the washing of flannel garments.

Singeing, sun-baking, and the use of hot flat-irons are briefly dealt with. The various methods devised for disinfestation by hot air and steam are treated of at length, and illustrated by text-figures of disinfestors improvised for war purposes, together with plates depicting the more elaborate forms of disinfectors designed for use in peace-time. We agree with the author that apparatus designed with a view to high efficiency against the resistive spores of bacteria is not adapted for rapid and economical use against lice. It should be replaced by more commodious hot-air and steam huts, or disinfestors planned on the improvised railway vans said to have been so successful in the East. Designs of this type of chamber should also be adapted for steam or motor lorries, as well as trailers, which could, if necessary, be horse-drawn.

Steam gives results superior to hot air if the destruction of pathogenic bacteria is an object, but dry heat possesses many advantages over steam if the destruction of body-vermin is the end in view. The use of sulphur is treated of at some length. We endorse the author's remarks as to the failure of sulphur vapour to destroy all the nits exposed to it, while its relatively high cost, the danger of injury to clothing, and its slow action are further disabilities of the method.

In the section dealing with insecticides and so-called repellents, the results of the great mass of experimental work are tabulated in detail, an unavoidable course owing to the wide diversity of method employed by the various workers. In these experiments lice and nits were immersed in, brought into contact with, and submitted to the action of the vapour of various substances and preparations.

We heartily congratulate the author on this valuable and exhaustive paper, and commend its careful study to all those concerned with the suppression of body-vermin.

MARINE BIOLOGY AT PLYMOUTH.

THE latest issue (vol. x., No. 4, May, 1918) of the Journal of the Marine Biological Association contains several papers of interest to fisheries investigators. Mr. D. Ward Cutler writes on the question of age-determination in fishes by inspection of the growth increments in the scales. The latter are built up of "sclerites," which are arranged in concentric, or rather confocal, bands, the focus being somewhere near the middle of the scale. Some of the bands of sclerites (those formed during the summer months) are relatively wide; the others that are formed during the winter months are relatively narrow. Thus the scale shows "annual rings of growth."

Mr. Cutler graphs his measurements of the sclerites, but gives a very bare account of the construction of the figures, so that his charts are not easy to understand. Plaice and flounders were kept in tanks artificially heated or cooled or of normal (seasonal) temperature. Some of the normal tanks were well supplied with food, and others were scantily supplied. Thus it became possible to distinguish between the temperature and the nutritional factors of growth. The latter do not affect the formation of broad (summer) and narrow (winter) bands. Abundant food leads to the production of many sclerites and meagre nutrition to few, but the relative width of the sclerites (and therefore of the confocal bands) is independent of food supply. On the other hand, the temperature of the water in which the fish lives influences directly the size of the sclerites, for those formed during phases of relatively high sea-temperature are large, while those formed during colder periods are small. They are formed in bands, and so the relative width of the latter reflects the annual wave of temperature change—even, Mr. Cutler suggests, the aperiodic fluctuations of the latter. All this is in line with other work on the metabolism of marine animals; it is really a case of velocity of chemical reaction, being proportional to some function of the temperature at which the reaction occurs. When the sea is relatively warm assimilation is speeded up, respiratory movements in a fish are quickened, and feeding increases. Decrease of temperature reduces tissue waste, and events happen in the opposite direction. But assimilation increases absolutely during the warmer phases, and so the marine fish "puts on flesh" during the summer months.

In the same journal Miss Marie Lebour gives extensive lists of the nature and relative abundance of the organisms forming the food of small, larval, and post-larval fishes of various species. She confirms, in general, but greatly amplifies, the observations of previous workers on the same subject. Even in quite small fish of some species, and with variety of food available, there is selection and quite evident preferences for certain food organisms. The paper is illustrated with some very admirable drawings of the heads of post-larval Pleuronectid fishes. J. J.

SCIENCE IN HORTICULTURE.

THE third annual report of the Nursery and Market Gardens Industries Development Society, Turner's Hill, Cheshunt, shows that continuous progress is being made in the application of science to horticultural practice. The fertiliser experiments are of considerable interest, and bring out the marked effectiveness of nitrogen compounds, especially of stable manure, in the growth of cucumbers, and their relative ineffectiveness in the growth of tomatoes. It is not definitely settled whether this result arises from some fundamental difference in the method of nutrition of the two plants, or simply from the relative drafts they make on the soil. The ineffectiveness of phosphates, both on cucumbers and tomatoes, is remarkable, and merits closer attention. An important technical matter is the demonstration that a relatively inexpensive mixture of artificial fertilisers gave larger returns than a mixture made by some of the best growers based on the best practice of the district. Fertiliser trials need considerable time for their execution, and it must be some time still before the experiments have yielded all the information they are capable of giving. They seem to support the old idea of an antagonism between fruiting and vegetative growth, for the methods which would normally produce the largest plants do not necessarily produce the largest amount of fruit.

Some interesting observations are recorded on the physiological conditions in cucumber-houses. There was found to be an appreciable correlation between the area of the seed-leaves and of the first rough leaf, and also a small correlation between the size of the seed-leaves and the dry weight after thirty days. Seedlings with the longest stems gave the largest crops. All these points are of great importance; it is remarkable that the later history of the plant should be so intimately bound up with its early properties. The grower has room in his houses only for a very limited number of plants, and he cannot afford to keep unprofitable seedlings.

Further experimental work was also undertaken on methods for the partial sterilisation of soil, and a serious combined effort is being made to solve the problems arising when these are applied in practice.

THE PALÆOBOTANY OF NEW ZEALAND.[1]

THE late Dr. Arber's memoir on the earlier Mesozoic floras of New Zealand is a particularly welcome addition to our knowledge of a much-neglected subject. In 1913 Dr. Arber published two papers on fossil plants from New Zealand, but the present paper covers a much wider field and deals very fully with a considerable number of species from Triassic-Rhætic, Jurassic, and Cretaceous strata. The specimens are the property of the Geological Survey of New Zealand, the British Museum, and the Sedgwick Museum, Cambridge.

The author shows that no Palæozoic plants have so far been discovered, and no undoubted examples of Glossopteris are included in the material examined. The genus which most nearly resembles Glossopteris is Linguifolium, instituted by Arber in 1913, but the author does not believe that the two are closely allied. The arguments in support of his view are, however, not conclusive. It is assumed that New Zealand did not form part of Gondwanaland, this term being used by Arber for a Palæozoic continent only, a more restricted usage than that adopted by Suess and some other authors.

[1] "The Earlier Mesozoic Floras of New Zealand." By Dr. E. A. Newell Arber. New Zealand Geological Survey: Palæontological Bulletin, No. 6, 1917.

Dr. Laurent, of Marseilles, contributes descriptions of a few Angiosperms from Neocomian rocks. The account of the Jurassic flora of Waikawa, Southland, includes an interesting description of a remarkable petrified forest composed chiefly of trees of an Araucarian type associated with petrified Osmundaceous stems. Forty-eight species are figured; of these at least fourteen are regarded as new, the remainder being widely distributed Mesozoic types. The admirable drawings and photographs are well reproduced, and there is an excellent bibliography.

This latest contribution by a palæobotanist whose untimely death is a serious loss to science is of great value from the point of view of phytogeographical problems; the author has cleared up several difficulties and corrected erroneous statements frequently quoted from the meagre literature on New Zealand plants. It is to be hoped that this thorough piece of work will stimulate New Zealand students to do their best to obtain additional material from the various localities in the islands, and thus provide data for the continuation of Dr. Arber's memorable work.

A. C. S.

VIBRATIONS: MECHANICAL, MUSICAL, AND ELECTRICAL.[1]

V.—*Brass Instruments and the Low "F."*

LEAVING the pendulums which have only two vibrations at a time, the case of brass instruments with a number of simultaneous vibrations was next considered. It is well known that the vibrations from most musical instruments are what is called compound. They consist of a series of tones of commensurate frequencies sounded together. Thus if the pitch of the note is said to be 100 per second, there is not only a prime tone of this frequency, but also a second tone of 200 per second, a third of 300 per second, and so forth. This law applies to strings, to open parallel pipes, and to a complete cone with its base open. It also applies as a close approximation to the brass instruments in general use. This approximation is traceable to the departure from the strictly conical forms as regards the mouthpiece, the bell, and the special shape of the intermediate portion.

In these brass instruments the possibility of this compound tone, or multiple resonance, is utilised for the production of distinct notes. Thus out of the tones possible to the instrument the player may elicit the set 200, 400, 600, 800, etc.; or the set 300, 600, 900, 1200, etc. These would be said to have the pitches of their primes or lowest components, 200 or 300 respectively. Or, to put it musically, they would be the octave or the twelfth of the fundamental (or *pedal*) possible on the instrument. The pedal of the instrument is not usually employed for musical purposes, but can be sounded if specially wished. Now there is a tradition among players of brass instruments that a note called by them a low "F" can be sometimes obtained. This note would have on the foregoing scheme the frequency $133\frac{1}{3}$. At first the possibility of this "F" seems scarcely credible to the theoretician. But after hearing and producing the note the necessity of accounting for its possibility was forced home.

Really the explanation proves very simple. It usually depends upon two points:—(*a*) The *spread* or *diffused resonance* of the pedal, and (*b*) its intentional *mistuning* with respect to the other notes of the instrument. These are taken in order.

(*a*) For theory shows that, other things being equal, the lower the note of such an instrument, the easier it is to force its vibrations out of tune, sharper or flatter. Thus with the pedal the range of resonance is such that the note may be sounded at any pitch whatever over a range of five or six semitones.

(*b*) Since the law of frequencies 100, 200, 300, 400, etc., is only approximately true for these instruments, in order to secure good relative tuning of the higher notes which are in constant use the pedal (which is not used musically) is purposely mistuned. On some instruments it may be, say, D or E♭ instead of C.

Hence, if the central pitch of the pedal is sharpened two or three semitones—and it is possible to force this note both up and down two or three semitones—it becomes possible to sound the pedal of true pitch C, to sound the low "F," and to sound notes of every pitch between. (This was demonstrated by Mr. White on a euphonium, kindly lent by Messrs. Boosey and Co.) The low "F" is also possible on the bombardon. Both these instruments are characterised by large conical tubing, and the low "F" is obtained by the spread resonance of the sharpened pedal.

In the case of the trumpet, cornet, and French horn with much narrow tubing the pedals are flattened, so that a pedal of true pitch can be obtained only by the spread resonance, and the "F" is impossible. On the trombone, which has much small parallel tubing, the low "F" may be obtained occasionally by the downward-spread resonance of the second partial (or note number two), which is an octave above the pedal. (Demonstration.) The pitches of the notes which have been obtained on six types of instruments by four experimenters are shown in Table II.

VI.—*Monochord Vibrations.*

Consideration was next given to the vibrations of stringed instruments, beginning with the monochord because of its striking simplicity.

From the work of mathematicians (with a little help from experiment) the various possible vibrations of strings, whether plucked, struck, or bowed, have long been well known. But a little reflection will show that many other problems are still left confronting the physicist. For identical strings, excited in the same way, but mounted on different instruments, will produce very different effects on the ear. In other words, the worth of a violin does not lie in its strings, but in its sound-box.

This leads to the inquiry as to what happens to modify the vibrations as, passing from the strings, they reach in turn the bridge, the belly (or soundboard), and the adjacent air.

It is easy to see that this problem is somewhat complicated, since it presents so large a number of variables. Thus there lie at the experimenter's disposal the pitch of the string, its material and dimensions, the place and manner of excitation, the material and disposition of the associated parts of the instrument, the place of observing the belly, the portion of the bridge observed and the directions of its motions, and, lastly, the spot at which the motion of the air is observed. In this way a scheme for more than a thousand observations could be sketched, even for an instrument with but one string.

Hence, no exhaustive treatment of the problem can be quickly obtained. But a beginning has been made, and by very simple means.

In a series of experiments simultaneous records have been photographically obtained of the vibrations of the string and of some other part of the instrument. The monochord was placed on a table and light from a vertical slit was focussed upon the string near its centre. The real image of this slit, crossed by the shadow of the string, was then focussed by a

[1] Abstract of a discourse delivered at the Royal Institution on Friday, March 8, by Prof. Edwin H. Barton, F.R.S. Continued from p. 439.

TABLE II.—*Spread Resonance of Lower Open Notes on Brass Instruments.*

Instrument and Key	Maker	Player		PEDAL	(Low "F")	No. 2		No. 3	
Trumpet E♭ in B♭	Boosey	D. J. Blaikley	F F♯ G A♭ A	B♭ (120)	.... F F♯ G A♭ A	B♭ (240)			
	Brown	E. H. Barton	E F F♯ G A♭ A	B♭	.... A♭ A	B♭	B		
	Hawkes	,,	A♭ A B♭ B C D♭ D	E♭	D	E♭			
Cornet in B♭		E. C. Pickerill	F.....G A♭ ..	B♭ (120)	.... F...... G A♭ ...	B♭ (240)			
	Boosey	E. H. Barton	E♭ E F F♯ G A♭ A	B♭	.... G A♭ A	B♭			
Trombone in B♭	Boosey	D. J. Blaikley	F♯ G A♭ A	B♭ (60)	..................(E♭) E F F♯ G A♭ A	B♭ (120)			
	Millereau	E. H. Barton	G A♭ A	B♭	B .... F♯ G A♭ A	B♭	B................	F (180)	F♯
French Horn in F	Boosey	D. J. Blaikley			C D♭ D E♭ E	F (90)	F♯...A B♭ B	C (135)	
	Boosey	E. H. Barton			E♭ E	F	F♯.......B♭ B	C	C♯
Euphonium in B♭	Boosey	D. J. Blaikley		B♭ (60)	B C C♯ D (E♭) .... A♭ A	B♭ (120)			
	Besson	E. H. Barton	A	B♭	B C C♯ D (E♭)E...................A	B♭	B		
Bombardon in E♭	Boosey	D. J. Blaikley			(A♭) .... C D♭ D	E♭			
	Besson	E. H. Barton		E♭ (40)	E F F♯ G (A♭) A .... C♯ D	E♭ (80)	E		
	,,	A. Wilkinson			E F F♯ G (A♭) .... C C♯ D	E♭	E		
	Boosey	D. J. Blaikley (March, 1913)		E♭	E F F♯ G (A♭) .... C♯ D	E♭	E F		
				full	fair poor fair full poor fair	full	fair poor		

second lens on to a photographic plate in a dark room. This plate was shot along horizontal rails by elastic cords, which were just slack when the plate received the light. Thus the plate moved uniformly and horizontally, while the shadow of the vibrating string showed its special motion vertically. The corresponding motions of bridge, belly, or air were obtained on the same photographic plate by the light reflected from a tiny rocking mirror, the slight tilt of which was produced by the motion of the part under test. (The principle of this experimental method was then demonstrated, the humped form of the curve due to plucking the string and the two-step zigzag produced by careful bowing being shown.) Fig. 3 gives a diagram of the method for the monochord, also a detail of the rocking mirror for the bridge's motion. Fig. 4 shows photographic traces for the monochord, string, and belly. The two curves alike were taken separately to test if the apparatus worked satisfactorily. The other two curves, slightly different from each other, show the distinction in appearance between the records of a bad and those of a good tone. In this work the assistance of Messrs. C. A. B. Garrett and J. Penzer was acknowledged. In 1914 Prof. C. V. Raman, of Calcutta, by experiments somewhat similar to the above, showed that the forward speed of a string where it is bowed is identical with that of the bow itself.

VII.—*Violin Vibrations.*

If the problems of the monochord were numerous and complicated, those of the violin are still more so, for there are now four strings instead of one; further, all are different in thickness and pitch, and are capable of use in sections of varying length. Again, the sound-

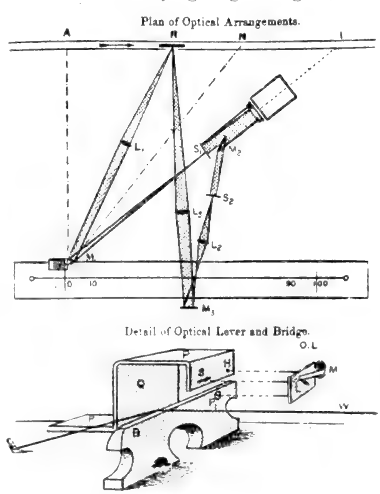


FIG. 3.—Monochord apparatus.

box is curved in a variety of ways. Finally, the reinforcement of the belly is asymmetrical. The bass bar lies almost under the fourth string, while the sound-post stands near that foot of the bridge which

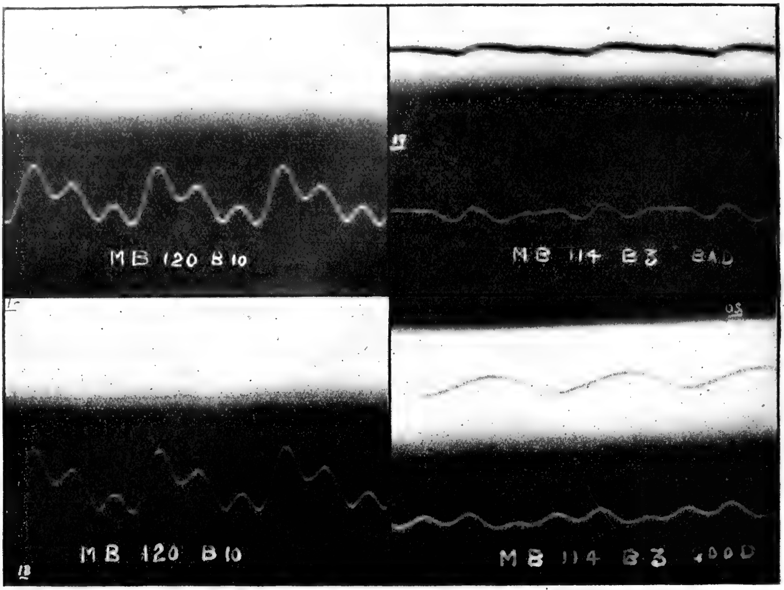


FIG. 4.—Monochord vibration curves.

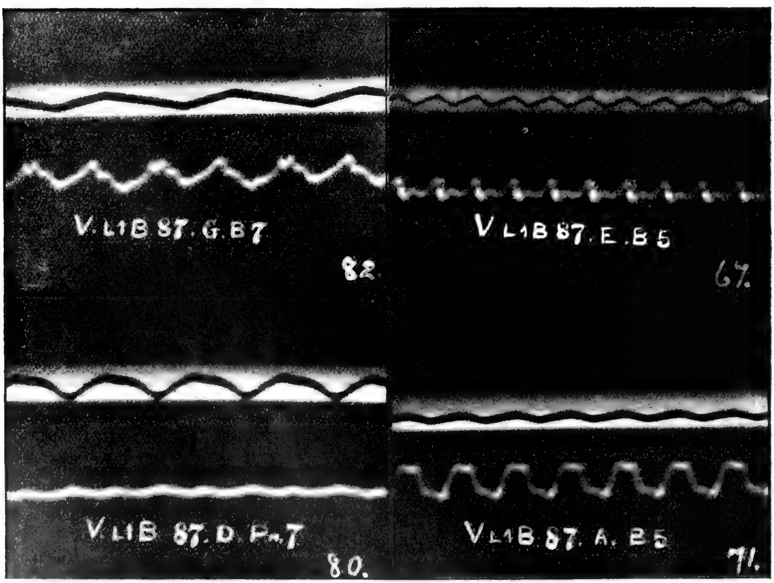


FIG. 5.—Violin vibration curves.

is under the first string. In the work on the violin assistance was received from Messrs. T. J. Richmond, T. F. Ebblewhite, and W. B. Kilby. A number of vibration-curves obtained for the violin were shown on the screen. Fig. 5 gives one set of these, showing the vibrations of each string as indicated by the letters

G, D, A, and E. The D string was plucked by a sharp point, the other strings were bowed. The white line shows the longitudinal motions of that corner of the bridge near which the first or E string passes.

VIII.—*Conclusion.*

With respect to the sympathetic vibrations occurring in stringed instruments, it is obvious that, though some little has been done, much more remains awaiting attack. Thus the violoncello, guitar, and harp might be dealt with, but especially, because of its immense vogue, the pianoforte needs thorough investigation. A start was made some time ago by Mr. G. H. Berry, and further researches are now in progress in London under the joint direction of men of science and piano manufacturers.

In the past music-lovers and men of science alike have been deeply indebted to the makers of musical instruments, who have themselves received but little help from science in return. The lecturer expressed the hope that science might shortly pay off part of its debt to the musical craftsmen of the country, and help to make the British piano second to none in the world.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Moxon medal of the Royal College of Physicians of London has been awarded to Dr. F. W. Mott. The Weber-Parkes prize is not to be awarded this year.

A VOCATIONAL Training Bill carrying an appropriation of 400,000*l.* has been passed by the U.S. Congress. It provides for a system of training for soldiers in more than three hundred trades.

A COMMITTEE has been appointed to inquire and report as to any improvements which may appear desirable to be made in the conditions of service and in the methods of remuneration of teachers in intermediate schools in Ireland, and in the distribution of the grants made from public funds for intermediate education, and as to the best means in the public interest of effecting such improvements. The members of the Committee are:—The Rt. Hon. T. F. Molony (chairman), the Lord Chief Justice of Ireland, the Rt. Hon. W. J. M. Starkie, Sir J. Larmor, the Rev. P. Canon Marshall, the Rev. T. Corcoran, the Rev. Brother Hennessy, Prof. J. M. Henry, Prof. R. M. Henry, Mr. J. Thompson, Miss H. M. White, Miss M. Ryan, Mr. W. J. Williams, Mr. C. R. Beavan, Miss A. McHugh, Miss E. Steele, Mr. G. Fletcher, Mr. E. Ensor, and Mr. M. Headlam.

THE governing body of Birkbeck College has appointed Dr. George Senter to the office of principal recently vacated by Dr. George Armitage-Smith, who had filled the position for more than twenty years. Dr. Senter, who is well known for his research and writings in chemistry, is head of the chemistry department of the college. Formerly he held the readership in chemistry at St. Mary's Hospital Medical School, and, in addition to important examining and tutorial posts in London University, held a seat on the University Senate. His election comes at an interesting time in the long and eventful history of the college, which, familiar to many thousands as a pioneer in public education, has continuously developed the scope and nature of its activities under Dr. Armitage-Smith, and has been recognised by Royal Commission as the future centre of evening university work in London.

THE report just received of the conference of representatives of provincial museums held at Sheffield on October 16–17, which dealt with the educational value of museums and the formation of war-museums, contains interesting accounts of what is being done in Manchester and other towns to bring the museums into closer relation with the schools, but beyond affording evidence of a desire on the part of museum authorities to depart from their traditionally passive attitude, the discussion shows little sign of any attempt to grapple with the principles upon which successful effort in this direction must be based. Neither circulating collections of museum objects nor organised visits to museums as such solve the educational problem. They often mean nothing better than a more elaborate form of the old-fashioned object-lesson, which is discredited because it commonly touches no vital interest. Reaction against verbalism may easily plunge us into another kind of abstract teaching, which is none the less abstract because it is based on things present to the senses. It is only when contact with an object is revealing, when it illuminates a dark place in our minds or opens up an aspect of the world hitherto unrealised, that it is, rightly speaking, educative. We may use it to give information, of course, but information has in itself slight educational value. From this point of view Mr. Haward's account of his work at the Manchester Art Gallery is the most valuable contribution to the subject. He has in mind a revelation, and, even though the children may not feel the ultimate message he would convey to them, it is precisely the ultimate message which should determine the whole procedure. This is true also of similar work in the museum, and a future conference might well address itself to the problem of this final outcome, for it is in the light of that we may hope to discuss profitably particular proposals and particular practice.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Irish Academy, June 24.—The Most Rev. J. H. Bernard, D.D., Archbishop of Dublin, president, in the chair.—H. **Ryan** and W. **O'Riordan**: **α-**, *β*-, and γ-trinitrotoluenes. An attempt was made to ascertain whether differences in the reactivities of the trinitrotoluenes exist which might explain the instability of trinitrotoluene in some rare cases. The behaviour of the three isomers towards alkalis, alkyloxides, amines, hydrocarbons, and aldehydes was examined. All three isomers yield black, amorphous, explosive bodies when heated with alkalis. The *β*- and γ-isomers have each one nitro-group replaced by a hydroxyl, giving dinitrocresols. The **α**-isomer yields hexanitrodibenzyl. The *β*- and γ-isomers readily exchange a nitro-group for an amino-group, the *β*-isomer being apparently the more reactive. The **α**-isomer forms additive compounds, without substitution, by interaction with amines. The additive compounds obtained from the γ-isomer and amines readily pass into substitution derivatives. Towards hydrocarbons such as phenanthrene the three isomers behave similarly. While **α**-trinitrotoluene interacts readily with aldehydes, forming stilbene derivatives, the latter could not be obtained under similar conditions from the *β*- and γ-isomers.

PARIS.

Academy of Sciences, July 16.—M. Léon Guignard in the chair.—G. **Bigourdan**: The observatory of the Hôtel of Taranne: works and co-ordinates. This observatory was founded about 1710 by Louville, who was the first to use a filar micrometer in astronomy, and measured the variation of the obliquity of the ecliptic. The exact position of the observatory is given.—P. **Termier**: The eruptive rocks interstratified in the Coal Measures of Littry (Calvados): the magnitude, variety, and duration of the volcanic manifestations in the Littry region during the Stephanian period. Two borings for coal have been recently made at Saint-Martin-de-Blagny and at Poterie. Although coal was not found, these borings have given valuable information on the constitution of the coal-bearing layers and on the nature of the volcanic eruptions mixed with the sedimentary deposits.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: New observations on the effects of intravenous saline transfusions after grave hæmorrhage. A description of experiments on dogs, in continuation of work published in earlier communications.—M. **de Sparre**: The advantages resulting from the use of a contraction at the entrance to reservoirs designed to attenuate hammering in pipes.—E. **Ariès**: The pressures of saturated vapour of octatomic bodies. The formulæ developed in earlier papers is applied to the experimental data on methyl formate, ethyl bromide, ethyl chloride, acetic acid, and ethane. Modifications in the values for the critical pressures and temperatures of ethyl chloride are required to bring the experimental and calculated values into agreement.—E. **Vessiot**: The trigonometrical developments of celestial mechanics.—Ed. **Chauvenet** and Mlle. H. **Gueylard**: The combinations of acid zirconyl sulphate with some alkaline sulphates. The existence of compounds of ammonium and sodium sulphate with acid zirconyl sulphate has been proved by thermochemical and cryoscopic measurements.—P. **Duret**: A new method for the rapid destruction of organic materials. The method is based on the oxidation by ammonium persulphate in sulphuric acid solution. The application of the method to the examination of urine for traces of arsenic is given in detail.—G. **Nicolas**: Anthocyanine and the respiratory gas exchange of leaves. A relation has been proved between the formation of the anthocyanic colouring matter and respiratory oxidation.—F. **Ladreyt**: The functional evolution of certain conjunctive elements.—C. **Cépède**: New means for the prognosis of pulmonary tuberculosis. The method is based on Arneth's figure from hæmatological data.—H. **Vincent** and G. **Stodel**: A preventive and curative serum for gas gangrene. The serum is obtained by injecting into the horse multiple bacterial races, including the principal anaerobic species causing gas gangrene. The protective action of the serum on guinea-pigs has been proved, and application to man has also been successful.

BOOKS RECEIVED.

National Reconstruction. By J. J. Robinson. Pp. viii+154. (London: Hurst and Blackett, Ltd.) 2*s*. 6*d*. net.

A Monograph of the Pheasants. By W. Beebe. In four volumes. Vol. i. Pp. xlix+198+coloured plates xx+photos 15+maps 5. (London: Witherby and Co.) 12*l*. 10*s*.

An Elementary Treatise on Curve Tracing. By Dr. P. Frost. Fourth edition revised by Dr. R. J. T. Bell. Pp. xvi+210. (London: Macmillan and Co., Ltd.) 12*s*. 6*d*. net.

Canning and Bottling. By H. Pixell Goodrich. Pp. x+70. (London: Longmans and Co.) 2*s*. net.

Plant Genetics. By J. M. and M. C. Coulter. Pp. ix+214. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press.) 1.50 dollars net.

The Twin Ideals: An Educated Commonwealth. By Dr. J. W. Barrett. Vol. i. Pp. xxxii+512. Vol. ii. Pp. xx+504. (London: H. K. Lewis and Co., Ltd.) 2 vols., 25*s*. net.

Treatise on Applied Analytical Chemistry. By Prof. V. Villavecchia and others. Translated by T. H. Pope. Vol. ii. Pp. xv+536. (London: J. and A. Churchill.) 25*s*. net.

Coal and its Scientific Uses. By Prof. W. A. Bone. Pp. xv+491. (London: Longmans and Co.) 21*s*. net.

Elements of the Electromagnetic Theory of Light. By Dr. L. Silberstein. Pp. vii+48. (London: Longmans and Co.) 3*s*. 6*d*. net.

The Stars and How to Identify Them. By E. W. Maunder. Pp. 63. (London: C. H. Kelly.)

Common British Beetles and Spiders and How to Identify Them. By S. N. Sedgwick. Pp. 62. (London: C. H. Kelly.)

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, AUGUST 15, 1918.

OLD UNIVERSITIES AND NEW NEEDS.

The Life of Sophia Jex-Blake. By Dr. Margaret Todd ("Graham Travers"). Pp. xviii + 574. (London: Macmillan and Co., Ltd., 1918.) Price 18*s.* net.

SOPHIA JEX-BLAKE was born in 1840 and died in 1912. The world, when she entered it, offered to an intellectual woman neither the education nor the openings which her more fortunate brothers enjoyed as a right and sought to preserve as a monopoly. It is to her, probably more than to any other individual, and to her long and often bitter fight in the women's cause, that their right to a liberal education has been conceded and the gates of the medical profession opened to them. She was a born chronicler and recorder, as well as a downright and formidable antagonist, and this, which has enabled her biographer to write a full and accurate account of her career, often stood her in good stead against her opponents. Reproduced as an appendix is the correspondence in the *Times* in which she replied to the representations of the Principal of Edinburgh University—a masterly instance of the power of facts over the most skilful advocacy and embroidery. As her biographer remarks: "The two letters represent two conflicting schools of historians, the one sweeping, picturesque, probable; the other definite, statistical, true."

Dr. Margaret Todd has worked through and drawn upon an immense accumulation of original material for her biography. Losing herself and her own personality in her task, her literary gifts severely confined to the sifting and proper presentation of voluminous correspondence, diaries, and other records, she succeeds in giving a living, human portrait of the old warrior and of what manner of women they were—how unlike popular caricature—who broke down the barriers and burst the fetters of the Victorian age. Around the central figure, her faults and her strength faithfully and sympathetically rendered, seeming to stand out by themselves without aid, so artistically has the elimination of everything not essential been performed, much of the history of the earlier phases of the women's moment has been reconstructed and much of permanent interest saved from oblivion.

But the book is something more than a biography of a remarkable personality and history of a period. It presents an epitome of the universal struggle between progress and reaction as it was fought out at one of the ancient seats of learning. That fight is over, the victory has been won, and the issue at stake has ceased to be a living question. Much of what is here recorded it is difficult to believe happened only fifty years ago. Is not this, it may be asked, itself a tribute to the magnitude and rapidity of the progress made? Unfortunately, progress is not to be measured by the magnitude of the opposition surmounted, nor is victory the term to apply to the forced retirement of the opposing armies from a position rendered untenable. The test of progress and of victory is the dominant spirit of the ancient universities to-day, and their attitude to the needs of the present rather than the past generation. It is just because, for this one celebrated instance, their devious and familiar methods of obstruction have been remorselessly pilloried by Dr. Todd that her work and the story she tells of the Edinburgh fight deserve a wider and more critical interest than would be aroused were it merely the biography of the protagonist or the record of a conflict long since decided.

As it is told here without rancour and with the minimum of the most moderate comment, the story is one that few to-day could read unmoved by indignation. No more soul-destroying labour can well be imagined than the task that must have been involved in its telling, the task of wading through the interminable insincerities, sophistries, evasions, and legal chicaneries by which an ancient university, having in an unguarded moment honestly sought the solution of a modern demand, then attempted to draw back and escape the consequences at no matter what cost to its honour and self-respect.

Regulations were duly framed by the University of Edinburgh in November, 1869, for the medical education and matriculation of women students, but every conceivable obstacle was then thrown in the path of the handful of young women who presented themselves. The onus of finding teachers willing to instruct them was put upon them, influence being exerted to prevent even those willing from undertaking the work. The medical students, on the outlook for mischief and ready "to follow a beck," were loosed upon them. The women students, mere girls for the most part, were pelted in the streets with mud and greeted with filthy epithets. One of them confessed in later life that she would make a detour of miles rather than pass the places where these incidents occurred. Another, who, when the storm first burst, had retired to the country "to listen to the nightingales," returned in earnest with an indignant protest at any woman being left to the care of the sort of practitioners these young ruffians would make. But, again, with the common sense and penetration characteristic of these early pioneers, she is found writing: "Do not be hard on the students. They are very bad, but they are not so bad as the professors." Posterity in the enjoyment of the fruits of victory is apt to be forgetful of its cost.

Two days prior to their first professional examination the medical faculty interdicted the issue of papers to the women candidates, and only withdrew under threat of legal proceedings. The Principal attempted to stop them matriculating, though, in the words of a friendly professor, he "had no more authority to issue this decree than a janitor." Though loyally supported by the then Lord Provost and many of the prominent citizens of Edinburgh, and by the powerful advocacy of the *Scotsman*, and having in the University many true friends, among whom Prof. Masson shines out conspicuously, the women students were finally driven to seek redress in the courts. One is appalled by the lengths to which an institution existing to minister to the desire for education went in its efforts to thwart and repress it. The University defended the suit, ultimately with success, on the ground that it had exceeded its legal powers when in 1869 it framed regulations admitting women! These legal proceedings form not the least instructive chapter. The women first won, but by a bare majority in a court of thirteen judges lost on appeal, the University being absolved from all responsibility to its matriculated women students, who were mulcted in the costs. As one of the dissenting judges ruled in his judgment, this puts the onus of defending the laws of the University, when their lawfulness is challenged, on the student who obeys them rather than on the authority that framed them. The University Court which framed the regulations it afterwards prayed to have declared illegal contained many learned in the law. To quote the *Times* letter already referred to: "It is a tolerably striking instance of 'the glorious uncertainty of the law' that the two highest judges in the land should concur in an action which is subsequently declared by a majority of their brethren to be illegal." Thus the Edinburgh battle ended. After Parliament had intervened and London University and the Irish Colleges had led the way, the University of Edinburgh twenty-five years later, in 1894, reopened its doors to women without further demur.

It would be difficult, after reading these proceedings, to retain much faith in the essential integrity of our laws and institutions and their suitability for the existing age. Were it not that precisely similar tactics are still available whenever an ancient university is confronted by a modern need, one could wish that the author, as she must often have been tempted to do, had given up the task of putting this indictment on record. As it is, a perusal of the book will serve to explain to many how it is that the ancient universities can lag so far behind the spirit of the age, and can drag the country with them even to the brink of national extinction. At a time when it is imperative for a century of arrears to be made up and great numbers of really educated men and women to be turned out to carry on and modernise the State, the old universities remain much as they were, paralysed by the past, and probably even less well disposed to change than they were fifty years ago. The exuberant, strange, and new vitalities which the growth of human knowledge and power has called into being within the last century hammer away at them from without. Monuments of bygone days, they remain changeless and resistant as marble, owning no law other than crystallised convention, no logic save that of the stricken blow. Is it always to remain a dream, Pygmalion-like, to desire them alive, the brain and heart of the age resident within their walls, and the elements of growth fostered rather than exorcised? The hardihood of the aspiration, rather than any hope of its fulfilment, is the abiding impression left by this record of pioneer achievement, epic of "progress" and "victory" though it be.

FREDERICK SODDY.

APPLIED BIOLOGY.

(1) *Mind and the Nation: A Précis of Applied Psychology.* By J. H. Parsons. Pp. 154. (London: J. Bale, Sons, and Danielsson, Ltd., 1918.) Price 7*s.* 6*d.* net.

(2) *The Third and Fourth Generation: An Introduction to Heredity.* By E. R. Downing. Pp. xi+164. (Chic., Ill., Univ. of Chicago Press; London: Camb. Univ. Press, 1918.) Price 1 dollar net.

(1) WITH special reference to present and imminent problems, Mr. J. Herbert Parsons makes a plea for the more strenuous and widespread study of psychology—"the Cinderella of the Sciences"—as a basis for clear thinking and progressive action. He sketches the evolution of behaviour, the ascent of man, the development of the individual mind, the growth of social consciousness, and the general trend of human history. With this impressionist survey as a background, he proceeds to show how the results of analytical and genetic psychology may be utilised towards an increasing understanding and an improved organisation of education, industry, and politics. To control effectively we must first of all understand the facts of the case, and we are handicapping our understanding by paying too little heed to psychology. Between biology on one hand and sociology on the other, psychology has a *rôle* of essential importance. Mr. Parsons states his case temperately and clearly, and we heartily recommend his timely volume to all interested in reconstruction and reorganisation. It is not for learned just persons, who need no repentance, but it will be useful to humbler people who wish to face the facts. It would be valuable to biologists of the materialistic school, who think that the psychological aspect is an efflorescence that does not count, and also to politicians who, while recognising that ideas have hands and feet, do not think a resolute study of social psychology necessary.

(2) Mr. Downing's excellent introduction to the study of heredity is an encouraging sign of the times. It is one of the "constructive studies" included in "The University of Chicago Publications in Religious Education," the editors of which are convinced that "faith must not operate apart from knowledge." We read in the editors' preface that "nothing can be more important in religious education than to train young people to use the careful methods of science in ascertaining the facts upon which their conclusions, not less in morals and religion than in other fields, are always to be based." The book has been prepared for young people's classes, and it would serve effec-

tively in the highest form in schools. It is with genuine appreciation of the success Mr. Downing has achieved that we join with the editors in recommending this little book, high-priced for its size, "to the reading of ministers and laymen who are desirous of obtaining in untechnical language the results which scholars have arrived at in this modern attack upon the problem of evolution." The author is a competent biologist with a keen educational sense. From data drawn from trotting horses and distinguished human families he shows that race counts. Which is the more potent, environmental nurture or hereditary nature? "Such a question is about as sane as whether wind or water is the more important in the production of the waves that surge in along the ocean shore." From mandrake flower and frog's spawn the fundamental facts of reproduction and development are illustrated; the import of Mendelian inheritance and of the selection of mutations is made clear; the question of the transmissibility of individually acquired somatic modifications is dealt with wisely and practically, and the inheritance of good and evil qualities in mankind is illustrated without exaggeration. The book expresses a clear mind, a well-balanced judgment, a eugenic ideal, and a belief in education. We wish for it a great success, which it well deserves.

OUR BOOKSHELF.

A Map showing the Known Distribution in England and Wales of the Anopheline Mosquitoes, with Explanatory Text and Notes. By W. D. Lang. Pp. 63. (London: British Museum Natural History, 1918.) Price 2*s*. 6*d*.

THE map deals with the distribution of the anopheline mosquitoes (*Anopheles maculipennis, A. bifurcatus, A. plumbeus* (*nigripes*)) previously recorded as indigenous and proved to convey malaria. The text contains records relating to the distribution of these mosquitoes, and, like the map, is modelled on the publications of Nuttall, Cobbett, and Strangeways-Pigg (1901), "Studies in Relation to Malaria: i., The Geographical Distribution of Anopheles in Relation to the Former Distribution of Ague in England," *Journal of Hygiene*, vol. i.; and Nuttall (1905), *ibid.*, vol. v., a considerable number of additional data being supplied from records hitherto unpublished. The statement made by the earlier authors that Anopheles are likely to be found in suitable waters anywhere in this country is confirmed. The features whereby the species may be identified are described, and a brief account is given of their life-history. Taken in conjunction with the earlier papers cited and those by Nuttall and Shipley (1901–3), "Studies in Relation to Malaria: ii., The Structure and Biology of Anopheles," *ibid.*, vols. i.–iii., readers will find in these sources most of the information that is obtainable regarding the insects. Their importance is fully appreciated now that indigenous cases of malaria have arisen more frequently owing to the return to England of soldiers with malaria, there being no reason why malaria should not become re-established and more widely distributed in this country if adequate precautions are not taken.

Wayfarings: A Record of Adventure and Liberation in the Life of the Spirit. By W. J. Jupp. Pp. 234. (London: Headley Bros., Ltd., n.d.) Price 6*s*. net.

THIS autobiographical study will interest many who have lived through the period of intellectual transition which had its keynote in the evolution-idea. It tells frankly, sometimes naïvely, of the author's "advance from the credulities of Calvinism to that liberty of open-mindedness which permits the continual readjustment of belief to the ever-widening experience of life." Greatly influenced by Wordsworth, Emerson, Thoreau, and Walt Whitman, he reached, after many wayfarings and much discipline, a serene faith in the orderliness, rationality, progressiveness, and purposefulness of the cosmic process. "The Universe must needs care for all its creatures." "The Spirit of the whole must surely be present and effective in all its parts." "The Creative Spirit of Life must be continually present and effective in all forms of its activity, in all creatures through which it lives and has its being." But what gives the book a special interest for us here is its disclosure of what the beauty of Nature—even in its most familiar expressions—may come to mean to a busy man in the way of "refreshment and inspiration and consoling grace." In the quietness of old age he went to a garden-city and continued to make his soul and to find "this world, with all its strangeness and apparent failure, a very homelike, habitable place." In the autumn, though he did not strain to listen, he heard the voice of spring. To many readers, especially of patient years, "Wayfarings" will give much pleasure.

Mathematics for Engineers. Part i., including *Elementary and Higher Algebra, Mensuration and Graphs, and Plane Trigonometry.* By W. N. Rose. (The Directly Useful Technical Series.) Pp. xiv+510. (London: Chapman and Hall, Ltd., 1918.) Price 8*s*. 6*d*. net.

THIS book contains a course on algebra, mensuration, and plane trigonometry for engineering students; the calculus, vector analysis, spherical trigonometry, differential equations, etc., being reserved for part ii., which is to appear shortly.

It is to be feared that a beginner may be somewhat confused by the arrangement adopted; thus Cardan's solution of the cubic occurs on p. 67, the rule for finding the area of a triangle on p. 79, and the definition of a circle on p. 90. Even the practical portions of the book are in places rather misleading: it must surely be easier to add logarithms vertically than horizontally. But doubtless the teacher will find the book a valuable mine for examples likely to interest the future engineer, as bearing on problems connected with his practical work.

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 Insectivorous Birds.

WHILE I cordially agree with Dr. Collinge's protest in NATURE of July 25, p. 407, against the indiscriminate destruction of small birds, I think he overrates the extent of the mischief that has been and is being done. No doubt the owners or tenants of market-gardens and orchards are not careful to distinguish between hurtful and beneficent species, but there are vast tracts of country where nobody dreams of killing song-birds, though schoolboys have been, are, and, I fear, will continue to be, incorrigible nest-harriers.

Dr. Collinge denounces the Wild Birds' Protection Act of 1880 and the amending Acts as "practically dead letters." Doubtless they share in the imperfection of all human legislation; but if they are inoperative in any district, the fault lies with the local authority. I had charge of two of the amending Acts in their passage through the House of Commons, and was strongly urged to prepare a schedule of species for universal application. I declined to do so, thinking it better to leave county councils to provide protection for such birds as local conditions rendered desirable. A schedule that might be suitable for Sussex would be grotesquely inapplicable to Caithness, and *vice versa*.

I will cite the goldfinch as illustrating good results from the Acts. It is not an insectivorous bird, but, whereas it subsists exclusively on the seeds of such weeds as thistle, charlock, coltsfoot, and the like, it must be reckoned among the farmer's and gardener's most diligent allies. It is more easily taken by decoy than almost any other song-bird, and is eagerly sought for by bird-catchers because of its popularity as a cage-bird. Owing to the nefarious industry of these gentry goldfinches had practically disappeared from Scotland when Lord Avebury passed his Act in 1880. About the end of last century they began to reappear. Here, in Galloway, the bird-catchers set to work with them at once, but a note to our Chief Constable put the police on the alert, and the mischief was stopped at once. Now we have plenty of these beautiful and beneficent finches, thanks entirely to the county council's powers under the Acts.

While I do not understand why Dr. Collinge describes the kingfisher and the dipper as "most beneficial," I am surprised that he does not mention the lapwing, an insatiable insect-eater. It is the only one of our wild birds of which both the carcass and the eggs are habitually offered for sale and eaten. Little harm is done by taking the early laid eggs, most of which would, if left on the ploughland, be destroyed in the process of sowing and harrowing, but to kill the birds should be constituted an offence.

Starlings have increased in numbers a hundredfold in my own recollection, and probably no single species of small bird accounts in this country for insects in the same quantity as they do. It must be owned, however, that ripening fruit crops require protection from starlings.

While I am very far from differing from Dr. Collinge on the importance of the subject of his paper, I venture to think that more good might be done by stimulating the activity of county councils in the matter of bird protection than by finding fault with the Acts enabling them to provide it.

Monreith. HERBERT MAXWELL.

WITH reference to Sir Herbert Maxwell's comments on my article in NATURE of July 25, I think he has overlooked one of the causes I mentioned in connection with the present scarcity of our insectivorous birds, viz. the severity of the winter of 1916–17 and, to a smaller extent, of that of 1917–18. I should like, therefore, to direct his attention to a recent and valuable report on the subject by Messrs. Jourdain and Witherby (*British Birds*, 1918, vol. xi., pp. 226–71; vol. xii., pp. 26–35), wherein they point out, as the result of a very careful and prolonged inquiry, the enormous mortality that has taken place, in some cases to the extent of 80–90 per cent. in certain counties.

The kingfisher and the dipper I regard as beneficial because both species consume a large quantity of injurious insects. In the case of the former species, an investigation upon which I am at present engaged shows that much of the food is of a neutral nature, and that any harm it does is more than counterbalanced by the good. I did not mention the starling, as I do not think that it requires any protection at present; indeed, in many parts of the country it is so numerous as to call for repressive measures.

I fully agree with Sir Herbert Maxwell's remarks on the lapwing, and would point out that under the name of peewit this bird is included in the schedule of the Act of 1880. Of the 106 local authorities out of 120 in England and Scotland that have put into force the amending Act of 1894 (57 & 58 Vict., c. 24), which prohibits the taking or destroying of wild birds' eggs, only eight Scottish authorities have placed this bird upon their list, and the ten English counties which protect the eggs of all wild birds (*cf.* Oke's "Game Laws," 1912, and Marchant and Watkins, "W.B.P. Acts," 1897). Why have the remaining eighty-eight authorities been waiting nearly a quarter of a century before doing the same? Again, only twenty-three authorities afford protection to the eggs of the skylark, 36·5 per cent. of the food of which is beneficial as against 13 per cent. injurious and 50·5 per cent. neutral. Numerous other instances might be quoted.

Whether one regards the Act of 1880 from the point of view of the ornithologist, farmer, fruit-grower, forester, or fisherman, it is unsatisfactory (i) in the number and species it affords protection to, (ii) in the penalties it imposes, (iii) in the absence of any provision for revision at stated periods, and (iv) in its lack of precision. Moreover, in entrusting the additions and general administration of the Act to the county councils it has proved largely ineffective.

WALTER E. COLLINGE.

The University, St. Andrews.

Preparing "Palates" of Mollusca.

PROLONGED cooking in a strong solution of soap is a much more satisfactory method of cleaning these interesting objects than the commonly recommended method with caustic potash. The plan which I have tried with success is to place the materials in the soap solution in a small phial, which is enclosed in a sand-bath, and then left on a hot part of the kitchen range. In a few hours all the surrounding tissues, or even the whole of the rest of the animal, is as completely disintegrated as it would be with the *liquor potassae* method, and the teeth all stand out bright and clear, but there is not the same risk of the so-called "palate" becoming disintegrated or curling up and becoming brittle. G. H. BRYAN.

STATISTICAL STUDIES OF DIETARIES.[1]

THE matter which is essentially new in this interesting and valuable report by Viscount Dunlace and Capt. Greenwood is a statistical study of the diet of workers fed in hostels and canteens attached to various factories under the Ministry of Munitions. The document also contains an independent analysis of available figures relating to working-class dietaries before the war, and it is prefaced by an exceedingly interesting appraisement of the practical significance which is attached to the results of modern experimental work on dietetics.

A careful study of food consumption under the conditions of canteen feeding must yield a valuable document. When, as in the majority of cases dealt with in this report, the whole nourishment of the individual is derived from an official food supply, the data become more trustworthy than those of most statistical studies, and there is the additional merit that individual consumption is not forced or otherwise affected by a predetermined ration such as exists in the Army. A further advantage is that the work done by various sections of the community, though not actually measured, nor perhaps measurable, is at least of a recognisable order of severity.

The average daily consumption "per man" of some 20,000 munition workers during the spring and summer of 1917 was found to consist of 115·7 grams of protein, 141·3 of fat, and 408·4 of carbohydrate. The average Calorie value of the food was 3463, a figure very near to the standard so generally accepted for a man doing moderately severe work. All the figures refer to food "as purchased."

The statistical method applied to nutritional studies has obvious limitations as a guide to practice, especially if guidance be sought when, as now, the national conditions are exceptional. Its results display the influence of appetite limited chiefly by economic conditions. If the latter are unfavourable, statistics of consumption do not guarantee the measure of an efficient diet. If conditions are favourable, the statistics may offer no guidance for economy. In this connection, however, the above data are perhaps more than usually trustworthy. The munition workers were well paid, but in the earlier months of 1917 there was an atmosphere tending to check extravagance, though as yet there was no feeling that the individual should go actually short. It is interesting to find, therefore, that the energy consumption was so closely similar to that of the working classes before the war. The average figure for the latter, as re-calculated by the authors from the Board of Trade returns, was 3571 Calories.

The dietaries of munition workers were, however, in a qualitative sense, abnormal, especially in the very high proportion of fat eaten. In this respect they cannot serve as a model for the present or for the immediate future. This high consumption of fat resulted from the circumstance that at the time when the statistics were being collected an acute shortage of potatoes co-existed with a vigorous "eat less bread" campaign. In one hostel, where the "voluntary" weekly bread ration of 4 lb. was literally accepted, the fat consumption rose to 214 grams a day! As the authors remark, this is a sufficiently instructive instance of what happens when the nutritional habits of the population are disturbed by force of circumstances or otherwise.

There is great difficulty in choosing a final expression for the results of statistical studies on the diet of a community. The demands of men, women, and children respectively have to be brought to some common denominator. This is usually done by expressing them all in terms of "man value." To take a woman's demands as eight-tenths of a man seems justified by the best data available. Much less satisfactory, however, are the factors hitherto used when growing boys and girls are concerned. To take the requirements of boys at thirteen as being 0·6, and of boys at fifteen as 0·7, of a man's (Atwater and Bryant) is certainly an error. The measurements of basal metabolism made and collected by Dubois, for instance, show that the requirements are proportionately high at these ages, so that a boy of thirteen wants little less food than his father, if the latter be a moderate worker. F. Gephard found, indeed, that the consumption at a large boys' school in Concord, New Hampshire, was nearly 5000 Calories per head per day.

This question is not fully discussed by the authors of the report, who, following the Food Committee of the Royal Society, used the Atwater factors. They show, however, in an appendix, to what an important degree the recognition that the demands of children are larger than was thought will affect current statements as to consumption "per man" when family budgets are dealt with. For example, taking the normal family of man, wife, and four children, the man value usually taken is $1+0·8+4\times0·51=3·84$. Taking the factor for children as 0·7 instead of 0·51, the man value becomes 4·6, and the *per caput* man consumption is reduced to 83·5 per cent. of its usually tabulated value. At any rate, a proper recognition of the requirements of children is of immense importance in budgeting for the nation.

Unfortunately, statistical studies do not tell us what at the moment it is so desirable to know. How far can the customary diet of a community be reduced without reducing its output of work? If reduction in food merely means inconvenience or even a degree of suffering, the nation will not fear it. What it has to fear is a consequential diminution in productiveness.

Even experimental studies have not yet given a satisfactory answer to the above important question. We know that if an individual under favourable conditions of nutrition will accept with equanimity a certain loss of body-weight, he may considerably reduce his consumption without

[1] "An Inquiry into the Composition of Dietaries, with Special Reference to the Dietaries of Munition Workers." Medical Research Committee; Special Report Series No. 13.

obvious loss of health, and, to judge from the work of Graham Lusk, his "efficiency" in the technical sense will not be affected. Work actually done will apparently be done at the same cost in Calories. We have, however, no certain knowledge as to how far that reduction can go (if it can occur at all) without affecting his ultimate capacity for work.

The review of modern experimental investigations with which the report opens well repays perusal as coming from authors highly qualified to appraise it from an independent point of view.

In connection with the experimental measurement of Calorie requirements, they do well to emphasise the point which Dr. Leonard Hill has recently made so clear—namely, that estimations made upon a man in a calorimeter at uniform temperature and in still air must not be applied in practice without proper qualifications. Vary the conditions, lower the external temperature, and especially increase the movement of air to which a resting man is exposed, and the demand goes up. It may be enormously increased.

Our knowledge concerning the energy requirement for the performance of external work is fully and very ably reviewed and appraised. It is shown that such data as those obtained by Benedict and Cathcart enable us to state with fair accuracy the increase in the demand for energy which goes with a given increase in work. This, however, applies only to work done within comparatively narrow limits. We have, for instance, no satisfactory data bearing on the cost of the more sedentary occupations.

In discussing the protein question the authors seem to be less at home. They do wrong, for example (though the point is perhaps of no great importance), in associating our modern conception of the metabolism of protein, involving, as it does, important chemical, as well as energetic, considerations, with the name of Rubner, who has given attention only to the all-important details of protein nutrition under compulsion born of other people's work. The authors justly pillory in the course of their historical discussion the vice of quotation at second hand; but it is just as bad to over-emphasise quotation from one particular original source unless its authority outweighs all others. On the protein question much more illuminating work and discussion have come from America and this country than from Germany.

The work embodied in this important document was carried out under the supervision of the Food Investigation Committee appointed by the Ministry of Munitions.

THE AFFORESTATION QUESTION IN BRITAIN.

In a previous article the present and future positions of the timber supplies of this country were considered. The afforestation question will now be briefly dealt with. Lord Selborne, in the House of Lords, recently asked whether the Government was in a position to announce its decision on the report of the Forestry Sub-Committee of the Reconstruction Committee, mentioning the pressing necessity for replanting which existed throughout the country. Lord Peel replied that the Government had accepted the report of the Forestry Sub-Committee, and that a central authority for the United Kingdom would be set up and planting be proceeded with with the least possible delay. This announcement will be greeted with approbation by all acquainted with the urgent importance of the afforestation problem. Differences of opinion on administrative questions exist, but these are trivial compared with the main object in view—the afforestation of the waste lands of the country. Forestry in its general aspects is a branch of economic industry of which the British public has known very little in the past. It is not surprising that it should have remained in ignorance of its importance. For we have no forests in Britain in the sense in which the word is understood in Europe and elsewhere in the world. Ours are pretty woodlands. In the future it will be necessary to grow commercial woods, for the war has demonstrated unmistakably that, as a mere matter of safety in the case of emergency, we must have a reserve supply of timber and pit wood in the country.

It has been already shown that we have to face the probability of all our commercially exploitable woodlands being cut out either during the war or in the years immediately following the peace. In 1914 we had 3,000,000 acres of woods in Britain. On a rough estimate half of these will disappear, and the areas occupied by them be replanted. This work is more a matter for the proprietors, who have received a high price for material which in many cases was almost unsaleable before the war. In some instances Government assistance may prove necessary. These fellings will not be all to the bad, since considerable areas, commercially worthless in pre-war days, owing to the poor methods on which they were grown, will have been cut out.

But these $1\frac{1}{2}$ million acres do not affect the main afforestation problem before the nation. Since the outbreak of war, Ministers and others have been wisely preaching thrift and conservation of the national resources. There are some $16\frac{3}{4}$ million acres of mountain and heath land in Great Britain, much of it bringing in a very small return per acre, from *2s. 6d.* down to a few pence.

Some of this land is above the limit in elevation of tree growth; other parts may prove reclaimable for agriculture. Land which is utilisable for the production of food should not be afforested. But there remains, so far as an estimate can be formed, at least some 3,000,000 to 5,000,000 acres which can be made to produce, in the national interests, a higher return both in money and general utility when placed under tree crops. Moreover, on these large areas of waste land—for, in the sense that they are not being put to their best use in the interests of the community, they are waste lands—it will be possible to demarcate blocks of a size capable of being worked on a commercially profitable scale, with systematic fellings which will guarantee a continuity in supply of material, reduce the cost of extraction of the material, cover the cost of upkeep, and yield a profit. Such areas of forest will maintain a larger population on the land, since forests require more people to look after them than the pasturing of sheep. They will also result in the employment of a considerable head of population in industries which arise in a wooded country—*e.g.* saw-mills, pulp-mills, furniture and box factories, etc.

The afforestation of these lands is not going to prove easy. The rich layers of soil they previously possessed have been long since dispersed, and the young plantations, bereft of shelter, will have to stand considerable exposure. We must be prepared for small crops during the first rotation. But even these should give a higher return than much of the land is at present yielding. Its afforestation will then be making a better use of the wastes, provide our descendants with a necessity for their industries, and give them a reserve for an emergency.

The land is at present in private ownership. An Act will doubtless be necessary in order to give the State the powers to acquire, in the public interest and at its marketable value, such land as it may deem necessary for reclamation for agriculture or for afforestation. But so far as afforestation is concerned it is unlikely that Government would be obliged to have recourse to the Act to effect the purpose in view. The acquisition of land by Government is undesirable if only on account of the friction it might give rise to. The better method of procedure will be by way of leasing areas from proprietors for a rotation (seventy years) or two rotations (140 years). The Development Commissioners have drawn up schemes on these lines. They offer to take over land from a proprietor on an ordinary lease and plant it up from their own funds (in conjunction with the Boards of Agriculture), the proprietor being given a small share of the proceeds from the woods, in addition to his annual rental; or, as an alternative, the proprietor to forgo any rental for his land, which will be planted up with money provided by the Commissioners, the two parties dividing the profits on a basis fixed by the amount of outlay incurred by each in the business. These offers appear to be mutually advantageous, and should result in the land required being obtained.

The selection of the land to commence operations upon can be left to the Forestry Advisers. These officers have the whole country divided up between them; they have been at work several years, and will be acquainted with the most favourable areas in their respective districts.

Now as to the cost of the undertaking. All figures have at present a problematical ring. But an all-round sum of 3*l.* per acre for the planting of the felled-over areas (1½ million acres), and 4*l.* for the waste land (rabbit netting is not included, as rabbits will have to be exterminated in the planting areas), should be near the mark; or 24,000,000*l.*, some 1,500,000*l.* to 2,000,000*l.* being provided by the proprietors. The amounts payable on the leases and upkeep, as also the more difficult problem of compensation for the removal of sheep stock in some cases, will be additional. Questions of space render it impossible to go into these matters. But they are details, though important ones, of the broad general scheme.

This area of 6½ million acres should give, under skilled management, 455,000,000 cubic feet of all classes of timber, or about three-fourths of the 1913 imports. It will only prove a safety margin, for our pre-war consumption was increasing annually, and available imports, at a reasonable price, will decrease in the future.

E. P. Stebbing.

AGRICULTURAL EDUCATION IN SOUTH AFRICA AND AUSTRALIA.

The *South African Journal of Science* for December last contains two articles on the organisation of agricultural education in South Africa and Australia respectively which deserve some notice, if only on account of the contrasts which they bring into prominence. Whereas in Australia the organisation seems to be complete from the bottom to the top of the ladder—from the elementary school to the university and research station—in South Africa, on the other hand, the conditions approximate to those existing in this country, where we have sporadic agricultural colleges catering more for the teacher of agriculture than for the farmer, and no effective link with the organisation of education generally.

In Australia the provision of what may be described as intermediate agricultural education appears to have reached a remarkable pitch of efficiency. The "colleges" there, which we should describe as "farm schools," aim at fully equipping the young farmer for the business of his life in a new country. Among the subjects taught are carpentry, saddlery, butchery, engineering, etc., and the writer of the article speaks of inspecting horseshoes, chisels, cultivator tines, complete sets of saddlery, all made by the students themselves. When we learn further that the lands of one of these "colleges" extend to 3500 acres, that upwards of 2000*l.* worth of stock is sold annually, and that 130 horses are maintained, we can form some idea of the seriousness of purpose with which the technical training is pursued.

Scientific progress is not neglected. In New South Wales alone there are fifteen State experimental farms, where the special problems of Australian agriculture are being systematically attacked. One result of considerable scientific interest may be noticed. It appears to have been established that, generally speaking, Australian conditions do not demand the use of nitrogenous fertilisers, and in a Government publication is found the remarkable statement that the Australian soil is "self-nitrogenating." Phosphatic manures, on the other hand, appear to be beneficial. Another feature of interest in Australian developments is the growth of farmers' institutes or bureaux, as they call them. In this country a remarkable and parallel development is now in progress (as an outcome of the war) in the shape of women's institutes. The guiding motive in both cases is the stimulation of interest in the problems of rural life through the agency of what modern sociologists would call "herd" instincts, for it seems possible to stimulate in a meeting intellectual interests which remain dormant in the home!

But in regard to agricultural science, Australia is, above all, fortunate in the number of special problems which, as a "new" country, it provides; the investigator finds numberless questions awaiting solution; he is not hampered by age-worn traditions and practices and the habit of mind which they engender; and he has not only a virgin field on which to demonstrate the efficiency of the new weapons which the scientific method has forged, but also, if we may judge from what is recorded, a population ever willing to hear, and even to adopt, some new thing. B.

NOTES.

THE British Scientific Products Exhibition, organised by the British Science Guild, is being opened by Lord Sydenham at King's College, London, as we go to press. The exhibition has aroused wide public interest, and there is no doubt that it will be decidedly successful in stimulating that close union between science and industry upon which progressive prosperity depends. Since the advent of the war much more intelligent attention has been paid to the co-ordination of these national activities than was given in earlier years. The spirit of distrust which existed between scientific workers and manufacturers has been largely dispelled, and an alliance is being formed which should go on increasing in strength for the benefit of each. The man of science formerly confined himself too closely to an academic atmosphere, and did not trouble to understand the problems of industry; while the manufacturer neglected to avail himself sufficiently of the potential industrial developments represented by the rich stores of scientific knowledge accumulated in the laboratory. During the last four years, however, science and industry have been brought into closer relationship, and some of the results of this *entente cordiale* are shown in the British Scientific Products Exhibition. Much yet remains to be done before we can recover all the ground lost by inactivity and unwise legislation; but by giving an indication of what has been achieved, a new spirit will be created which should lead to further progress.

WE much regret to see the announcement of the death on August 10, at seventy-eight years of age, of Prof. O. Henrici, F.R.S., emeritus professor of mechanics and mathematics in the Central Technical College of the City and Guilds of London Institute.

THE *Times* announces that Mr. W. M. Crowfoot, of Beccles, Suffolk, who died on April 6 at eighty years of age, bequeathed a collection of exotic butterflies and moths to his wife for life and then to the Natural History Museum, University College, Nottingham; a collection of shells from the Paris basin, his crag-shells, and other fossils to the Norwich Museum; a collection of shells from the Italian Pliocene basin and a collection of marine, land, and fresh-water shells to the Ipswich Museum.

AN association of chemists engaged in the oil and colour and allied trades has been formed for the purpose of considering and discussing the many complex points which are continually met with in the course of their work. The need for this association has been felt for a long time, and the work undertaken by the chemists of the paint trade on the linseed-oil substitution products has been the foundation on which the association has arisen. The first president is Dr. F. Mollwo Perkin, and the secretary Mr. H. A. Carwood, 53 Groombridge Road, London, E.9.

THE autumn meeting of the Institute of Metals will be held in the rooms of the Chemical Society, Burlington House, on September 10 and 11. Among the communications to be submitted are:—The Resistance of Metals to Penetration under Impact, including a note on The Hardness of Solid Elements as a Periodic Function of their Atomic Weights, Prof. C. A. Edwards; Grain Growth in Metals, Dr. Z. Jeffries; Rapid Recrystallisation in Deformed Nonferrous Metals, Mr. D. Hanson; The Influence of Impurities on the Mechanical Properties of Admiralty Gunmetal, Mr. F. Johnson; and A Peculiar Case of Disintegration of a Copper-Aluminium Alloy, Dr. R. Seligman and Mr. P. Williams.

THE MINISTER OF MUNITIONS has issued an Order prohibiting the purchase, sale, or delivery of any radio-active substances, luminous bodies, or ores without a permit, and providing that such returns of stocks, etc., shall be made as are from time to time prescribed. The Order applies to all radio-active substances, including actinium, radium, uranium, thorium, and their disintegration products and compounds, luminous bodies in the preparation of which any radio-active substance is used, and ores from which any radio-active substance is obtainable, except uranium nitrate and radio-active substances which at the date of the Order form an integral part of any instrument, including instruments of precision or for time-keeping. Applications in reference to this Order should be addressed to the Controller of Optical Munitions, Ministry of Munitions, 117 Piccadilly, W.1.

PROF. STEPHEN FARNUM PECKHAM, who has died at Brooklyn at the age of seventy-nine, was director of the chemical department of the U.S. Army Laboratory during the Civil War. He held successively the chairs of chemistry in Washington and Jefferson Colleges, Maine Agricultural College, Buchtel College, and the University of Minnesota. In 1898 he was appointed director of a laboratory of the Commissioner of Accounts of New York, and later of the Department of Finance of that city. He had been State assayer to Maine, Minnesota, and Rhode Island. He was the author of an elementary book on chemistry as well as of a report on the production, technology, and uses of petroleum and of a treatise on solid bitumens.

THE death is announced, in his sixty-seventh year, of Dr. Richard Rathbun, the acting director of the Smithsonian Institution at Washington. On graduating at Cornell University in 1875, he was appointed assistant geologist to the Geological Commission of Brazil. In 1879 he was for a short time an assistant in zoology at Yale. He was scientific assistant on the U.S. Fish Commission from 1878 to 1896, having charge of the scientific inquiries subsequent to 1887, and from 1892 to 1896 he was the U.S. representative on the joint commission with Great Britain relative to the preservation of fisheries in waters contiguous to the United States and Canada. Dr. Rathbun was appointed curator of the U.S. National Museum in 1880, assistant secretary to the Smithsonian Institution in 1897, and had been in charge of the U.S. National Museum since 1899. He had written largely on palæontology, marine invertebrate zoology, and the administration of fisheries and museums.

THE death in Paris is announced of Prof. Richard Norton, son of Mr. Charles Eliot Norton, professor of fine arts at Harvard. Richard Norton was director of the American School of Classical Studies in Rome from 1899 to 1907. He came of good English stock, and was related, on the English side, to the Sidgwicks and the Darwins. He was at once a trained archæologist, an excellent classical scholar, a critic of fine art, and an adventurous explorer. He worked in Greece with Waldstein, with Boni in Rome, with Hogarth in Egypt, and on his own account in Cyrene. At the beginning of the war he organised the American Volunteer Motor Ambulance Corps, and during the Champagne battle in October, 1915, he disclosed the fact that the German gas apparatus captured dated so far back as 1908, thus proving that the barbarous methods of the enemy had been long premeditated. He received the Order of the French Legion of Honour and the Croix de Guerre for gallantry under fire, and was awarded the British Mons medal.

THE position of this country as regard the supply of optical glass at the outbreak of war is often not clearly understood. We are glad, therefore, to correct any misapprehension which may have arisen from an incidental reference to the subject in an article on the British Scientific Products Exhibition in NATURE of August 1. Optical glass has been manufactured in this country since 1848 by Messrs. Chance Bros. and Co., Birmingham. When the supply of German glass was cut off in 1914, the experience gained by this firm became an important national asset, and through it an acute situation was saved. Messrs. Chance have supplied nearly the whole of the optical glass required for instruments used by our Forces during the war, and also much of the requirements of our Allies, without any assistance from the formulæ determined by the Glass Research Committee of the Institute of Chemistry. This committee rendered invaluable aid to the manufacture of scientific and heat-resisting glassware, but the needs of optical-instrument makers were met independently by Messrs. Chance, whose output since the outbreak of hostilities has increased twenty-fold. Without their seventy years' experience it would have been very difficult to have produced the supply of optical glass imperatively demanded by conditions of war.

As is well known, the Germans were anticipated by some savage tribes in the use of poisonous gas for war purposes. In a paper entitled "Palisades and Noxious Gases among the South American Indians," by Mr. Erland Nordenskiöld, in *Ur Ymer, Tidskrift utgiven av Svenska sällskapat för Anthropologi och Geographi* (Arg. 1918, H. 3), he quotes authorities, such as Staden, Oviedo y Valdés, and Thevet, to show that tribes like the Tupinambá and Guaranis of the Brazil littoral and on the Rio Parana used poisonous gases in attacking fortified villages. Men went in front of the attacking party, each holding a pan with embers in one hand, and ground red pepper in the other; when the wind was against the Spaniards they sprinkled the pepper on the embers. This was also done in attacks on the Spaniards in Venezuela. In the same way pepper was largely used in exorcising demons and evil spirits. The use of this pepper, known as Aji, would soon be discovered by these Indians, who cultivate the plant extensively. It was only necessary for someone to upset a basin of Aji into the fire, and a hut would soon be cleared of its occupants. The use of the smoke in warfare would be a natural development.

THE entrance of the United States of America into the war has prompted Mr. A. Hansen to write to *Science* pointing out that the States possess no national floral emblem. France has its fleur-de-lis, England the rose, Scotland the thistle, but America has no flower with which it is associated in people's minds. Mr. Hansen points out the various characteristics required for a national flower, and comes to the conclusion that the columbine, which is in flower from April to July, is probably the most suitable for the purpose. The correspondence of the generic name Aquilegia with the Latin name of the eagle is also considered to be a point in its favour. Colorado has already adopted the columbine, which is native throughout the States; and though the flowers are somewhat fugitive, no other flower seems to be as suitable. In a later contribution to *Science*, by Mr. F. L. Sargent, it is pointed out that the national flower question was considered so long ago as 1895, and a history of the matter is given in Trans. Mass. Hort. Soc., part 1, 1898. It was then considered that the columbine was the most suitable flower, and its use for the purpose is strongly advocated by Mr. Sargent. Another writer, however, suggests the golden rod (Solidago), a common plant in the States, which has previously been advocated, but does not seem so suitable for national purposes as the more elegant and beautiful columbine.

THE future of the Hevea rubber industry in the Federated Malay States and the East generally is a matter of serious consideration and some anxiety. Not only is *Hevea brasiliensis* attacked by various parasitic fungi, such as Fomes, pink-rot, and Phytophthora, some of which have received careful investigation from mycologists, but there are also questions connected with the soil and other conditions of the plantations which also need careful attention. All who are in any way interested in the future of the rubber industry should make a careful study of Prof. J. B. Farmer's address on "Science and the Rubber Industry," delivered before the Royal Society of Arts, and published in the society's Journal for June 21 last. The picture he draws, though somewhat gloomy, is none the less true. Possibly the hope of the future lies in breeding varieties of rubber immune to disease, but this will scarcely be possible until we have a fuller knowledge of the true function and precise chemical composition of the latex of *Hevea brasiliensis*. Moreover, despite the chairman's (Sir Edward Rosling's) remark that there was no direct evidence of a great variation of yield of rubber amongst different trees, there is, as Prof. W. Bateson pointed out, a very large body of evidence that there are wide differences, and of such any breeding experiments will have to take due account. It is much to be hoped that there will be no delay in taking steps to safeguard adequately the true interests of the rubber industry and its future prosperity.

THE British occupation of Jerusalem has already, in one important respect, conferred upon the inhabitants the benefits of sanitation. Within the short space of four months, despite difficulties of transport and unfavourable weather, a scheme of water-supply has been devised, executed, and put into commission.

The antiquated and germ-infected method of purveying water in leathern bags through the agency of the water-carrier is now superseded by a series of standpipes at various points in the city, fed by a main leading from an untainted source in the hills, where there is a group of springs yielding some 14,000 gallons per hour, which was previously running to waste. During the long period of Ottoman misrule, with its characteristic indifference to health and cleanliness, no attempt had been made to deal with this fundamental question of water-supply. Domestic requirements were met, in a haphazard fashion, from underground cisterns, replenished during the winter rains, most of them polluted and encrusted with dirt, and some even in a ruinous condition. Pending further developments, the British authorities have arranged to refill these domestic reservoirs as often as may be necessary on the preliminary stipulation that they shall be thoroughly cleansed and put in order; a British sanitary officer takes good care to see that this requirement is rigidly observed. The inhabitants can have as much water as they need, and the consumption is stated to be ten times as great as it was last year. The hospitals receive a supply direct from the main.

THE fine series of Maori burial-chests in the Auckland Museum, with a few isolated specimens in other collections, are described in *Man* for July by Dr. W. H. R. Rivers and Mr. H. D. Skinner. The chests were used in secondary burial, the bodies being first placed in trees and the desiccated bones collected for re-interment. The custom of placing the dead or their bones in caves is widely spread in Oceania, but neither elsewhere in New Zealand nor in any other part of Polynesia do we know of such chests. Receptacles, often in human form, are, however, used in Melanesia, notably in the Solomon Islands, to preserve the skull or skeleton. In the case of the New Zealand chests, similarity with Melanesian culture comes out in the nature of the chests themselves. In many respects in which the carving departs from the usual characteristics of Maori art it approaches that of Melanesia; and it is noteworthy that the part of the northern island of New Zealand where these chests have been found is characterised by the prominence of negroid or Melanesian characters in the physical features of the inhabitants.

A VIVID description of caribou hunting in Newfoundland appears in the *Brooklyn Quarterly* (vol. v., No. 2). The author, who signs himself "R. H. R.," is chief taxidermist to the Brooklyn Museum, and recounts his experiences during a trip undertaken for the purpose of providing six specimens for the museum. Incidentally, he has some hard things to say of the professional hunter. "These men who hunt for meat are a bloodthirsty lot. They do not hesitate to kill in excess of their legal allowance of three caribou. The wholesale butchery . . . in Newfoundland is a revolting sight." This state of affairs calls for immediate measures if the extinction of the herds is to be prevented. The author fears that they will go the way of the bison if the present rate of destruction is not speedily checked.

MR. R. C. MURPHY, in *Sea Power* for June, gives a brief but illuminating account of the whale fishery of South Georgia, and the part it has played in furnishing glycerine for the manufacture of high explosives. Even before the outbreak of war the humpback whale had been dangerously reduced in numbers, and the announcement in this article that the oil of this animal is particularly rich in glycerine gives occasion for grave forebodings as to the fate of this particular species. But the exigencies of the times have also demanded a very heavy toll on the rorquals of Antarctic waters. This much is apparent from the statement that by the beginning of 1917 no fewer than 660,000 barrels of whale-oil had been dispatched to British ports. For the sake of the future of the whaling industry, not only in these waters, but also at the Cape—for the one depends upon the other—we trust that the issue of whaling licences will be thoroughly revised on the advice of scientific experts, who, until now, have not been consulted in the matter, which has been administered entirely by the Colonial Office.

THE improvement of the natural indigo industry is a subject which is receiving much attention from scientific workers in India, and one aspect of the question is dealt with by Mr. C. H. Hutchinson in a paper entitled "The Importance of Bacterial Action in Indigo Manufacture" (Calcutta: Thacker, Spink, and Co., 1917, pp. 11). The yield of indigo from a given weight of indigo plant is found to depend upon the intervention of bacteria during the steeping process, and while some bacteria operate beneficially, others are detrimental. In the absence of the former the yield is reduced, and the author considers that the presence of these beneficial forms could be secured by artificial inoculation. Some alterations in the shape of the steeping-vats are also suggested in order to bring the bacteria normally present in the walls of the vats into closer connection with the indigo plant.

KEW Bulletin Nos. 2 and 3 were published together, mainly because they contain a valuable paper by Sir David Prain on the genus Chrozophora (Euphorbiaceæ), one species of which is a Languedoc plant, the source of one of the litmus dyes known as turnesol. Both the history of the genus and careful accounts of all the species are given. The paper occupies some seventy pages, but is much too technical for a brief review. In the same Bulletin there is an interesting account of experiments which have recently been made in breeding the West African oil-palm *Elaeis guineensis*, both on the Gold Coast and in the Seychelles. The object in view in these experiments was to see if the soft-shelled variety of the oil-palm would breed true, but it has been found that this is far from being the case under the conditions of the experiments. Palms grown from soft-shelled seed have yielded both hard- and soft-shelled nuts even in the same bunches of fruit, and it is clear that no decisive results can be obtained until care is taken to hand-pollinate the flowers of a soft-shelled tree with pollen from a tree of similar character and to protect the flowers, as cross-fertilisation must be of constant occurrence. Not only is it desirable to produce nuts with thin shells easy to be cracked, but it is also necessary to breed varieties of palms which shall be prolific bearers of fruit yielding the finest quality oils. Hitherto the oil-palm has only been a wild crop, but it is of interest to note that recent attempts to cultivate it on the Gold Coast have met with remarkable success, the yield from palms grown in tilled soil at fair distances apart being more than three times as large as that from palms under native conditions. The establishment of plantations in the Federated Malay States and the Seychelles may therefore lead to far-reaching results, and under these more favourable conditions the oil-palm may so flourish that the native industry, unless properly cared for, may collapse and disappear.

ON October 1, 1917, a disturbance, evidently due to an air-wave, was reported at certain places on the Dutch coast. Doors flew open and shut, pictures swung on the walls, and windows clattered. The

Meteorological Institute at De Bilt attributed the disturbance to an explosion which occurred at a munitions factory in the North of England. Accepting this explanation of the phenomenon, a writer in *Oesterreichische Flug-Zeitschrift* for January, 1918, regards it as evidence of a strong current from north-west in the upper air. This current is identified with the one that carried the German airships over France when returning from a raid in England last October, and is referred to as the summer monsoon prolonged into the autumn.

THE Germans are greatly troubled in finding a satisfactory substitute for platinum. Now, however (according to *Metall und Erz*, May 22), they have found that for certain purposes an alloy of nickel and iron may replace platinum. The alloy—called "platinite"—may be used in electric lamps. Nickel-chromium is sufficiently resistant to chemical action to make it a fairly good substitute for platinum for laboratory purposes. Cobalt stands up to strong acids even better than nickel. The low melting-point of gold makes it unsuitable for some purposes, but the melting-point may be raised by adding palladium. The Bureau of Standards (U.S.) has recently tested this latter alloy (known as "palau"), and found it to be superior to platinum in some respects, though inferior in others.

THE April Bulletin of the Bureau of Standards contains a study of the electromagnetic moving-coil galvanometer for alternating currents by Mr. E. Weibel. After obtaining the equations of motion of the coil, he shows that the deflections are proportional to the component of the electromotive force applied to the coil in phase with the excitation of the laminated magnet. The period is shortened by inductance and lengthened by capacity of the external circuit. The intrinsic constants of the instrument are easily determined by experiment, so that the behaviour of the instrument under specified conditions is readily foretold. The instruments which have been constructed on the lines laid down in the paper have a sensitivity at low frequencies much greater than the telephone, greater than the vibration galvanometer, and about equal to the best direct-current instruments. At high frequencies of the order 2000 many precautions must be taken to ensure accuracy; amongst others, the moving coil and circuit near it should be enclosed in a metal shield kept at the same potential as the coil.

A TIMELY article on "Planning a Research Laboratory for an Industry," by Dr. C. E. K. Mees, of Rochester, New York, appears in the July issue of the *Scientific Monthly*. The research laboratory, for example, of a textile-dyeing business with an annual turnover of 200,000*l*. per annum should cost about 2000*l*. and the equipment about 1000*l*. It should have, to begin with, a staff of four with salaries totalling 2000*l*. per annum. The organisation should be on the departmental system—that is, there should be a head of the laboratory and three heads of departments of physics, chemistry, and biology respectively. As the laboratory justifies itself, additions to the staff of each department will become necessary, and these additions will be responsible to the heads of departments, although with further growth provision should be made for their becoming heads of new departments. The great object of the firm should be to get hold of a capable man for the head of the laboratory, as success or failure depends on him. If such a man is available it is best to leave the organisation in his hands, for there is no evidence for the belief that an investigator is not a good administrator.

To the *Biochemical Journal* for June Dr. J. C. Drummond contributes an account of further work on what has been called the "water soluble B," or water-soluble accessory growth-promoting substance (compare NATURE, March 21, p. 52). The influence of the substance upon the nutrition and nitrogen metabolism of the rat was studied. The food consumed by rats fed upon a diet deficient in the water-soluble accessory substance seems to be reduced to that sufficient to supply the calorific requirements of maintenance, and, although the consumption may be increased by the addition of flavouring agents (*e.g.* meat extract) to the diet, no growth is observed unless the agent contains the water-soluble substance. Addition of an extract of the latter to the inadequate diet causes a greatly increased food intake, immediately followed by growth, and the amount of growth is proportional, within certain limits, to the amount of accessory substance added. Evidence was obtained that the length of time a rat can maintain its body-weight upon a diet deficient in the water-soluble substance is directly proportional to the age at which the restriction is imposed. The only apparent deviation from the normal nitrogen metabolism by rats fed upon the deficient diet was the appearance of creatinuria, accompanied by a slow wasting of the skeletal muscles. The cause of the fatal decline which inevitably follows a deficiency of the water-soluble substance was not discovered, but symptoms of nerve disorder were observed before death in three cases. Actively growing animal tissues (embryos, tumours), desiccated pituitary gland, thyroid, thymus, testicle, and ovarian tissues are deficient in the "water soluble B."

THE New York State Barge Canal, which it was anticipated would be opened to navigation in the early part of this year, is the subject of an interesting article in the *Engineer* of July 19. It is the development of a network of antique waterways dating back, in part, to the beginning of last century. The principal member of the system is the old Erie Canal, linking up Lake Erie with the River Hudson; this was begun in 1817 and completed in 1825. As originally constructed, it had a depth of 4 ft. and a width of about 42 ft. Similar and adjacent enterprises followed, but the advent of the locomotive and the development of railway construction exercised a deterrent influence, so that ultimately several of them failed and had to be shut down. The canals which survived, although enlarged from time to time to meet the growth in size of vessels, gradually lost influence and declined into relative obscurity. In 1882 the Erie Canal had a depth of only 7 ft., and the largest boat carried was of 240 tons burthen. The scheme just completed provides a minimum depth of 12 ft., and minimum widths of 94 ft. in rock cuttings and 125 ft. in earth excavation respectively. The project has, in fact, been so designed as to render it possible to accommodate boats up to 3000 tons, though for the present the bulk of the craft using the canal will scarcely exceed 1500 to 2000 tons. As yet there is a lack of boats of a suitable type, and opinion is much exercised on the matter; possibly the solution of the problem may lie in the adoption of reinforced-concrete construction. There are fifty-seven locks on the new waterway, each 328 ft. long and 45 ft. wide. As the dimensions of a 1000-ton barge recently built—the first of a fleet of such boats for service on the canal—are 152 ft. long and 22 ft. beam, there is evidently ample margin for future expansion. All the locks are operated electrically. The lock at Little Falls, with a range in level of 40½ ft., is notable in that its range is greater than that of any single lock on the Panama Canal. The syphon lock at Oswego, with a range of 25 ft., is the first of its type to be constructed in the United States, and is believed to be the largest of its kind in the world.

WE have received a copy of a paper by Mr. K. J. J. Mackenzie and Dr. F. H. A. Marshall, of Cambridge, on "The Inheritance of Mutton Points in Sheep." The paper is published in the Transactions of the Highland and Agricultural Society, 1917, and consists of an account of Mendelian cross-breeding experiments upon merino and Shropshire sheep, carried on over a number of years at Cambridge, and involving three generations of animals. The points dealt with ("over the shoulder," "behind the shoulder," "loin," and "top of leg") show a marked degree of segregation among the cross-bred sheep.

THE special feature of the July issue of the "Readers' Guide," just issued by the Norwich Public Library Committee (post free 2*d.*), is a section devoted to the work of Mr. A. H. Patterson, whose valuable collection was recently presented to the Norwich Public Library. A short account of this well-known naturalist's life and writings, by Mr. Geo. A. Stephen, the city librarian, is followed by an annotated bibliography (extending to five pages) of his writings, arranged under the following headings:—Manuscripts, Books and Pamphlets, and Principal Articles. The bibliography, which shows that Mr. Patterson is a prolific writer, should be of much interest and use to naturalists.

OUR ASTRONOMICAL COLUMN.

BORRELLY'S COMET.—This periodic comet, which was observed in 1905 and 1911, has been detected on its return by M. Fayet, director of the Nice Observatory, the position on August 7·6205 G.M.T. being R.A. 3h. 39m. 52s., S. decl. 16° 14′. M. Fayet, who obtained a very extensive series of observations in 1911–12, had previously computed the first order perturbations by Jupiter and Saturn, and obtained the following elements for 1918 (Marseilles Observatory Circular, No. 29):—

$$T = 1918 \text{ Nov. } 16{\cdot}3484 \text{ G.M.T.}$$

$$\left.\begin{aligned}\omega &= 352^\circ\ 23'\ 29{\cdot}44''\\ \Omega &= 76^\circ\ 55'\ 52{\cdot}86''\\ i &= 30^\circ\ 29'\ 27{\cdot}28''\end{aligned}\right\} 1918{\cdot}0$$

$$\phi = 37^\circ\ 57'\ 5{\cdot}78''$$

$$\log a = 0{\cdot}5593451$$

$$\log q = 0{\cdot}1448107$$

The observation indicates that the true value of T is near November 16·62.

The following ephemeris (for Greenwich midnight) is computed with the uncorrected value of T:—

	R.A. h. m. s.	S. Decl. ° ′
Sept. 3	4 40 36	13 37
7	4 49 20	13 10
11	4 57 57	12 41
15	5 6 28	12 9
19	5 14 51	11 33
23	5 23 6	10 54
27	5 31 13	10 11
Oct. 1	5 39 10	9 22

Values of $\log r$, $\log \Delta$: September 3, 0·20980, 0·08128; October 1, 0·17291, 9·96205 respectively.

THE AUGUST METEORS.—These phenomena appear to have returned this year under a more brilliant and abundant aspect than usual. Mr. Denning writes from Bristol that he made observations on July 30, August 2, 5, 6, 8, 9, and 10, and that the number of meteors visible increased with the time. On August 9 forty-nine meteors were seen in 2½ hours' watching, and on August 10 forty-eight were observed in 1¾ hours. On the former date twenty-five Perseids were included in the total, and on the latter thirty-one. The position of the radiant point exhibited the usual displacement from night to night to the north-east. The character of the radiation this year seems to have been more dispersed or diffused than is sometimes the case, and, far from being "a point," the radiant formed an area extending over a diameter of six or seven degrees.

Several fine Perseids were observed, and their positions, as seen from Bristol, were as under:—

Date	G.M.T. h. m.	Mag.	Path From ° °	Path To ° °
August 5	13 54	♀	269 +84½	230 +65
8	12 47	♃	320 +82	256 +70½
9	10 33	3×♀	332 −13	326 −23
	10 56	♀	17½+48	5½+40
	11 6	♃	293 + 3	284 −12
10	10 4	5×♀	33 +84	245 +83
	11 42	♃	20 +20	18 +12½

On August 10 a 2nd mag. meteor was seen at 9.54, which had a very long flight of 75° from 62°+77° to 257°+28°.

The night of August 11 was much overcast at Bristol, and all that could be seen was an occasional brilliant meteor in openings of the clouds.

On August 12 the sky was splendidly clear, and an attentive watch, amounting to 2¾ hours in the interval between 9h. 45m. and 13h. 45m. G.M.T., revealed 120 meteors, of which ninety-six were Perseids. The shower was quite brilliant and abundant, though the maximum had probably occurred on the previous night. A magnificent Perseid was seen at 12h. 41m. G.M.T. shooting from 28°+46° to 18½°+35°, and leaving a bright streak. These August meteors have furnished an unusually fine display this year.

THE FUTURE OF THE IRON AND STEEL TRADES.

ON July 31, 1916, Mr. Walter Runciman, the then President of the Board of Trade, appointed a Committee to consider the position of the iron and steel trades after the war, especially in relation to international competition, and to report what measures, if any, are necessary or desirable in order to safeguard that position. The Committee consisted of representatives of employers, employed, and those engaged in technical practice. At its first meeting it decided to address to the manufacturers' and workmen's associations in the trades and to the trade Press a circular letter indicating the nature of the inquiry upon which it was engaged, and inviting assistance and co-operation. In reply a number of detailed statements were received, which in the great majority of cases were supplemented by oral evidence.

The Committee states that it has endeavoured to approach the question of the future of the position of the iron and steel industries with a mind free from preconceived political views and economic theories, and that its purpose has been, not to test abstract doctrines, but to establish an ordered plan of action. Political existence, it says, must be founded on commercial and industrial strength, and the problem to which it has attempted to find a solution is:—"To give to the nation industrial resources which in time of peace shall preserve the prosperity of Great Britain, and in time of war shall give her full command of resources adequate to the defence and safekeeping of the Empire."

The scope of the inquiry was so wide that it was decided to treat various subjects separately, and a number of interim reports dealing with special subjects have been issued. These are incorporated in the general report, which was presented to Sir Albert Stanley in June, 1917. It will be seen, therefore, that the Committee completed its labours in about eleven months, and that a year has elapsed between the presentation and publication of its report. The latter is divided into fourteen sections, in regard to which limits of space permit reference to only two. It should be stated, however, that, generally speaking, the Committee failed to reach unanimity on most of the points discussed. Nearly all the interim reports are either signed with very decided reservations by certain members, or else accompanied by a minority report emphasising fundamental disagreement. It is true that the general summary of recommendations is signed by each member of the Committee, the numbers of which were reduced to nine by the death of Mr. Colville in December, 1916; but three of these, in doing so, direct attention to various dissenting statements of theirs in the body of the report. Sir Hugh Bell evidently came to very different conclusions from those reached by his brother employers, and has expressed them in a series of minority reports.

As regards what may be called the future position of labour in the industry, which is one of the most fundamental aspects of the problem, the sectional report is signed by five members, and more or less dissented from on three separate grounds by the remaining four. In the succeeding section, dealing with "Protection," the same five members recommend that the industry should be protected by the imposition of customs duties "upon all imported iron and steel and manufactures thereof," that a specific duty should be levied in each class of commodity, and that there should be maximum, general, and minimum tariffs. Messrs. Gavin and Hodge, while agreeing with this, consider it imperative that safeguards should be provided by the Government against the raising of prices unduly against the consumer and to the disadvantage of labour. On the other hand, Sir Hugh Bell and Mr. Davidson in their dissenting statement say:—"We entirely disagree with the foregoing report, which proposes to inflict on the community Protection in its most unmitigated form. Neither the grounds on which this course is recommended nor the means which it is proposed to adopt to accomplish it are, in our judgment, justified by the facts of the case. . . . A country of which the exports of iron and of the ultimate products of the manufacture of iron amount to more than one-third of the total value of the iron trade itself, and to something like one-quarter of the total export trade of the country, can by no stretch of language be described as not being self-sufficing." It will certainly not be easy to legislate on the basis of this report.

H. C. H. C.

NEW X-RAY TUBES.

THE war has brought about an activity in the production of the "Crookes" or X-ray tube that has become decidedly to our advantage. At the commencement of hostilities a certain amount of anxiety was felt as to how the great demand that was immediately created could be met; not only was the manufacture of these tubes rapidly falling into German hands, but we were also entirely dependent upon that country for the supply of the peculiar glass necessary for their construction. Happily the difficulties have now been overcome. The production of tubes of higher efficiency and excellence than was ever reached before the war has been achieved, and at the present time all the demands both for military and home needs can be met. This success is not confined to British manufacturers, but is shared by both our American and French Allies.

The invention by Dr. Coolidge in America of the ionic discharge tube has placed in the hands of the radiologist a highly efficient tool that will produce a volume of X-rays of any desired power of penetration. These tubes are supplied in England by the British Thomson-Houston Co., of Upper Thames Street.

Messrs. Watson and Sons, of Great Portland Street, W., are the sole agents for a very complete series of tubes produced by M. Pilon in France. These have been specially designed to meet military needs, and are beautifully constructed pieces of apparatus; some thousands of them have been supplied to the Allied Armies. There are also many excellent tubes of home construction that are being produced in London as rapidly as the present restricted labour conditions will allow. Of these we may mention the series known as the "Zenith" tubes, manufactured by Messrs. A. E. Dean and Co., of Holborn. In these tubes the new glass devised for the purpose by Sir Herbert Jackson is used, and they are London-made throughout.

Many other British-made tubes are on the market, so that there is thus every hope that another important industry has been saved from becoming a German monopoly.

THE POSITION OF UNIVERSITY AND HIGHER TECHNICAL EDUCATION.

I.—SUPPLY AND OUTPUT OF STUDENTS.

TWO of the chief subjects dealt with in the report of the Government Committee on the position of natural science in the educational system of Great Britain, of which a summary was given in NATURE of April 18, are (1) the need for concerted efforts to increase the number of students at universities and higher technical institutions with the view of securing a larger supply of trained scientific workers required for industrial and other purposes, and (2) that increased grants of public money are required to equip the universities for their work in pure and applied science, and to enable a substantial reduction of fees to be made. Few particulars are given in the report to show how the position of Great Britain as regards university and higher technical education compares with those of countries like Germany and the United States, though the evidence which such a comparison affords strengthens greatly the case presented. It may be worth while, therefore, to bring together some facts which accentuate the need and urgency of action in the directions indicated by Sir J. J. Thomson's Committee.

The first report (1915–16) of the Advisory Council for Scientific and Industrial Research pointed out that the prime condition of success for its operations was a largely increased supply of competent researchers. "Before the war," the report remarks, "the output of the universities was altogether insufficient to meet even a moderate expansion in the demand for research. The annual number of students graduating with first- or second-class honours in science and technology (including mathematics) in the universities of England and Wales before the war was only about 530, and of these but a small proportion will have received any serious training in research. We have frequently found on inquiry that the number of workers of any scientific standing on a given subject of industrial importance is very limited. . . .

"The responsibility for dealing with the grave situation which we anticipate rests with the education departments of the United Kingdom. We shall be able to do something to encourage a longer period of training by the offer of research studentships and the like; but that will not suffice. It is useless to offer scholarships if competent candidates are not forthcoming, and they cannot be forthcoming in sufficient numbers until a larger number of well-educated students enter the universities. That is the problem which the education departments have to solve, and on the solution of which the success of the present movement, in our opinion, largely depends."

Sir J. J. Thomson's Committee confirms the statement of the Advisory Council for Scientific and Industrial Research that the total annual output of the first- and second-class honours men in science and engineering for all the English universities is little more than 500. The total number of full-time men students who entered the universities and university colleges of England and Wales (excluding the medical schools) in the year 1913–14 was no more than 4400, and of these some hundreds were foreign students. It is estimated that nearly half this number were from the public schools, from which about 5200 leave annually at sixteen years of age or above, and 25 to 30 per cent. proceed to the universities. In the case of the State-aided secondary schools, the number leaving at sixteen years of age or above is approximately 8800; and the Government Committee estimates that from 12 to 15 per cent. pass to a university. This estimate is, however, probably too high, not more than about 10 per cent. of such students proceeding to universities. As a rule, the State-aided secondary schools devote more attention to science and other modern studies than do the public schools; and it is to them that we must chiefly look for an increased supply of university students to be trained as scientific workers.

In order to determine the position of the United Kingdom as regards education of a university standard in comparison with those of the United States and Germany, the conditions existing in the academic year 1913–14—that is, immediately preceding the opening of the war—have been analysed. The results show that much remains to be done to increase the number of university students from whom the supply of research workers must chiefly be drawn. The number of full-time students at the universities of the United Kingdom in 1913–14 was nearly 27,000, distributed as shown in Table 1.

1.—*Full-time Students at Universities of the United Kingdom*, 1913–14.

	Universities	Students
England	10	15,550
Scotland	4	7,550
Ireland	3	2,470
Wales	1	1,140
	18	26,710

In comparing the number of students attending universities and technical institutions of like rank in different countries, it is necessary, of course, to take population into account. Also, in making any exact comparison, the standard of the work at each university should be known. It is very difficult to derive these particulars from any published reports, but sufficient facts are available to enable a general comparison to be made. Table 2 shows the number of university students per 10,000 of population in the United States, Germany, and the United Kingdom. Students at technical institutions of university rank are included; and in the case of the United States only students in the seventy-two universities, colleges, and technical schools on the accepted list of the Carnegie Foundation for the Advancement of Teaching. If all students taking four-year courses at these institutions in the U.S.A. were included, the number and rate per 10,000 would be doubled.

2.—*Full-time Students at Universities and Higher Technical Institutions, and Ratio to Population.*

	Population	Students in Universities and Technical Institutions	Rate per 10,000
United States ...	100,000,000	100,000	10
Germany	65,000,000	90,000	13
United Kingdom ...	45,000,000	29,200	6
England	34,000,000	17,000	5
Scotland	4,800,000	8,000	16
Ireland	4,400,000	3,000	6
Wales	2,000,000	1,200	5

The number of students in universities and technical institutions of like rank may be taken as a rough index of national regard for intellectual equipment and high technical training. Judged by this standard, England and Wales occupy the lowest position among the countries represented in the foregoing table. Both in the United States and Germany there has been in recent years an increase in the number of university students far in excess of the increase of population, whereas before the war the reverse was the case in England and Wales. While industrial prosperity has been accompanied by an increase in the proportion of university students in the United States and Germany, the rate of increase of such students in England and Wales has diminished.

The number of collegiate and resident graduate students in universities and other institutions of university rank in the United States in 1913–14 was 210,500, made up of 139,400 men and 71,100 women. The number annually completing four-year courses and receiving bachelor degrees is about 26,000. In addition, in 1913–14 there were conferred 5250 graduate degrees and 520 doctorates of philosophy by examination.

The number of students in the twenty-one universities of Germany in 1913–14 was about 68,000, 58,000 of whom were matriculated students. The distribution of the students in the different faculties is shown in Table 3.

3.—*Number of Students in German Universities*, 1913–14.

	No. of Student
Faculty of Theology	5,840
,, ,, Jurisprudence, etc. ...	10,290
,, ,, Medicine	16,300
,, ,, Philosophy	25,780
Total matriculated students ...	58,210
Non-matriculated students ...	9,900
Grand total	68,110

In regard to the number of students receiving technological training of an advanced kind, the position of England and Wales is even worse than that shown by the proportion of university students. At the Imperial College of Science and Technology there were, in 1913–14, 700 such students; at Cambridge the number of candidates who presented themselves in the Natural Sciences Tripos, the Mechanical Sciences Tripos, and various special examinations in other branches of science was about 500; at Oxford the number of students of Natural Science was about 300; and at the Manchester College of Technology, 285. Most of the technical colleges in England and Wales are connected with the universities of their respective areas. Others provide technical institution courses approved by the Board of Education for students above seventeen years of age. Such provision for full-time education in applied science is, however, as the Board has pointed out, regrettably small in bulk compared with the needs for the industrial development of the country. In the year 1913–14 there were, in the twenty-six technical institutions recognised by the Board, fifty-four technological courses in engineering, chemistry, and subjects connected with the building, mining, textile, and leather trades, many of which were also attended by some students preparing for degrees; and five scientific courses mainly in provision for professional qualifications. The number of students taking the full courses was 1236, of whom 539 were in their first year, 374 in their second year, 269 in their third year, and 54 in later years of their courses. The numbers of full-time students of science and technology in all these universities and colleges are shown in Table 4.

4.—*Full-time Students in various Faculties of Science and Technology (excluding Medicine) in Universities and University Colleges in Receipt of State Grants* (1913–14).

	England	Wales
Pure science	1,620	234
Engineering, including naval architecture	1,085	44
Technology, including mining, metallurgy, and architecture ...	459	34
Agriculture, horticulture, and dairy work	221	58
	3,385	370

There are fifty-two agricultural and mechanical colleges for white students in the United States. These may be regarded as comparable with our technical institutions, and most of them are incorporated in universities. In these cases the students are included in the numbers given for universities. The number of undergraduate students in four-year college courses in the United States colleges of agriculture and mechanic arts in 1914 was 40,000; and the chief groups are shown in Table 5.

5.—*Students in Colleges of Agriculture and Mechanic Arts, U.S.A.*

	No. of Students
Agriculture, horticulture, and forestry ...	14,250
General science	4,360
Mechanical engineering	4,100
Civil „	3,480
Electrical „	3,280
General „	2,610
Chemical „	780
Mining „	680
Chemistry	610
	34,150

The number of degrees conferred in 1914 in agricultural and mechanical sciences were:—

	Agricultural Science	Mechanical Science
Bachelor degrees	1,900	1,960
Advanced „	150	150
	2,050	2,110

There are eleven technical high schools in Germany having the power of granting degrees. The number of students in these schools in 1913–14 was nearly 17,000, of whom 11,600 were fully qualified. It is not possible to make any exact comparison between the German technical universities and our technical institutions or the applied science faculties and departments of British universities. The matriculation for fully qualified students at the German technical high schools is the completion of the full nine years' secondary school course at a classical, semi-classical, or modern secondary school, and is practically equivalent in standard to a pass B.A. degree at one of our universities.

In our own technical institutions the standard and age of admission are much lower, and if we count all the students at these institutions as well as those in applied science departments of universities the number is less than 5000, to compare with the 17,000 students in German technical high schools. In addition to these schools there are four agricultural high schools with 1750 students; five veterinary high schools with 1570 students; four forestry academies with 300 students; three mining high schools with 800 students, as well as other special schools; and in all these the educational qualifications for entrance are the same as at the technical and older universities.

Dr. F. Rose, a few years ago, made a detailed report to the London County Council upon technical education in the United Kingdom and Germany; and he showed that there are few technical institutions in the United Kingdom which can be compared with any of the great German technical universities. Good technical colleges and departments in England appear to be on a level with the best technical schools in Germany rather than with the technical universities. "Looked at," said Dr. Rose, "from the basis of the German standard of previous education and practical work, length, extent, and variety of the courses taken, and the number of diplomas granted, it will probably be found that there are insufficient students in the whole country to fill one of the large German technical universities"

II.—Financial Provision.

A comparison of the financial provision made for university and advanced technical training in the United Kingdom with what is available in the United States and Germany reveals our deficiencies just as decidedly as does that of the number of students. With the exception of Oxford and Cambridge, all the universities and university colleges in England and Wales participate in Parliamentary grants, the amounts of which, as well as other sources of income, are shown in Table 6.

6.—*Incomes of Universities and University Colleges in Receipt of Exchequer Grants* (1913–14).

	England (18 Institutions)		Wales (4 Institutions)	
	Amount	Percentage of Total	Amount	Percentage of Total
Fees	£190,300	28·1	£17,600	27·2
Endowments ..	100,300	14·8	4,200	6·5
Donations and subscriptions	20,700	3·0	2,100	3·3
Annual grants from local authorities ..	108,500	16·0	3,800	5·9
Parliamentary grants ...	230,100	34·0	35,700	55·3
Contributions from hospitals, etc., for services rendered ...	1,500	0·2	—	—
Other income .	26,200	3·9	1,200	1·8
	£677,600		£64,600	
Grand total ...		£742,200		

It will be seen that the income from endowments of the eighteen universities and university colleges of England and Wales in receipt of Exchequer grants amounts to about 100,000*l*. Manchester receives about 23,000*l*, annually from endowments, or 27·5 per cent. of its total income, whereas King's College, London, receives only 62ol., or 1·6 per cent. of its income. Manchester University, Liverpool University, and University College, London, together have nearly half the total income from the endowments of the universities and university colleges in England which participate in the Exchequer grant.

In general, it may be said that these institutions derive about one-third of their total incomes from Parliamentary grants; the percentage of income from other sources varies so greatly that no general statement other than the averages given in the above table can be made.

In addition to the universities and university colleges in receipt of Exchequer grant, a number of medical schools and a few other institutions received in 1913–14 Parliamentary grants amounting to about 33,000l., or one-quarter of the total incomes. The total of the annual Parliamentary grants to these universities, colleges, and medical schools in England and Wales is about 300,000l. The grants are made up as shown in Table 7. Twenty-four institutions in all participate in the grant for technological and other professional (including medical) work, and ten of them are also in receipt of portions of the Exchequer grants to universities and colleges.

7.—*Heads under which Incomes from Parliamentary Grants are derived by Universities, University Colleges, and Medical Schools.*

	England	Wales
Exchequer	£170,000	£31,000
Board of Education, in respect of technological and other professional work	46,890	430
Board of Education, in respect of training of teachers	19,910	4,730
Board of Education, other grants	20,440	250
Other Government departments	19,560	4,780
	£276,800	£41,190

The financial provision made by the State for university, medical, and higher technical education in the United Kingdom is about 500,000l. annually. Of this amount England and Wales receive about 300,000l., Scotland about 84,000l., and Ireland about 100,000l. The total annual income of all the universities and university colleges in the British Isles, including the Universities and Colleges of Oxford and Cambridge, is about 2,000,000l.; that of universities and colleges in the United States is 20,000,000l., and of universities in Germany 1,800,000l. Particulars of the incomes of institutions in the United States are given in Tables 8 to 12.

8.—*Income of Universities, Colleges, and Technological Schools of the United States* (1913–14).

	Amount	Percentage of Total
For tuition and other educational services	£4,500,000	22·5
From invested funds ...	3,500,000	17·5
Donations and subscriptions	2,700,000	13·5
Grants from State or city ...	6,000,000	30·0
United States Government grant	1,000,000	5·0
Other sources	2,300,000	11·5
	£20,000,000	100·0

The incomes of individual universities in the United States are very high in comparison with those of most of our universities. Seventeen universities have each an annual income equal to, or in excess of, the total Parliamentary grants to universities and colleges of England and Wales, and nine have incomes equal to, or in excess of, the total Parliamentary grants to university and higher technical education in the whole United Kingdom. The incomes of these United States universities are shown in Table 9.

9.—*Annual Incomes of Seventeen Universities in the United States*, 1913–14.

University	Income
Cornell University	£1,300,000
Columbia ,, ...	1,300,000
Harvard ,, ...	860,000
Chicago ,, ...	660,000
Minnesota ,, ...	600,000
Wisconsin ,, ...	600,000
Illinois ,, ...	560,000
California ,, ...	500,000
Yale ,, ...	500,000
Michigan ,, ...	440,000
Northwestern University	300,000
Wellesley College, Mass.	300,000
Missouri University	300,000
Washington University, Missouri ...	300,000
Princeton University	300,000
Ohio State ,, ...	300,000
Pennsylvania ,, ...	300,000

Five States of the U.S.A., four of them with populations of about two millions each, gave grants to universities in 1913–14 exceeding the total Parliamentary grants to universities and colleges of England and Wales. These are shown in Table 10.

10.—*State Grants to Five Universities in the United States.*

State	Population	Grant
Minnesota	2,000,000	£500,000
Illinois	5,600,000	400,000
Wisconsin	2,300,000	400,000
California	2,400,000	300,000
Michigan	2,800,000	300,000

The benefactions to universities and colleges in the United States are similarly far in excess of those devoted to such institutions in the United Kingdom. The total amount of gifts and bequests to universities and colleges in the United States in the year 1913–14, excluding grants by the Federal Government, different States, and municipalities, was more than 5,000,000l. Of this amount nearly 4,000,000l. was for endowment, giving in a single year, if invested at 5 per cent., an increased endowment income of 200,000l., or double the income derived from all the endowment funds of the whole of the modern universities and university colleges of England and Wales. The chief gifts in 1913–14 are shown in Table 11. In addition, forty-five universities, colleges, and technological schools each received gifts above 20,000l.

11.—*Private Benefactions to Universities of the United States*, 1913–14.

University	Benefactions
Cornell University	£800,000
Harvard ,, ...	400,000
Chicago ,, ...	300,000
Yale ,, ...	200,000
Washington ,, ...	200,000
Columbia ,, ...	200,000

The gifts and bequests to universities and colleges in the United Kingdom in the year 1913–14 amounted to about 200,000l.

The incomes of the colleges of agriculture and mechanic arts in 1913–14, excluding the grants for experiment stations, amounted to 7,000,000*l.*, made up as shown in Table 12.

12.—*Incomes of Agricultural and Technical Colleges, U.S.A.*

Sources	Amount	Per cent.
From States	£3,600,000	52
Federal Government ...	700,000	10
Tuition fees and endowments	2,700,000	38
	£7,000,000	100

The total income of these technical colleges is thus nearly ten times that of the whole of the universities and colleges in England and Wales in receipt of Exchequer grants; and 60 per cent. is derived from State or Federal grants in comparison with 40 per cent. from Parliament and local authorities combined in the case of universities and colleges of England. It may be added that the normal State expenditure per annum on higher agricultural education in England and Wales is about 20,000*l.*, and 35,000*l.* for agricultural research, or not much more than a single State in America receives for similar purposes.

The incomes of twenty-one German universities in 1913–14, not including the technical high schools, amounted to nearly 1,800,000*l.*; and of this the State provided 1,500,000*l.*, or more than 80 per cent. of the total. The universities with incomes approaching 100,000*l.* or more are shown in Table 13.

13.—*Incomes of Eight German Universities.*

University	Income	State grants	Per cent.
Berlin	£246,000	£205,000	81
Leipzig ...	231,000	190,000	82
Breslau ...	112,000	82,000	73
Halle	111,000	74,000	67
Bonn	100,000	75,000	75
Kiel	99,000	65,000	66
Göttingen ...	94,000	50,000	53
Königsberg ...	92,000	72,000	80

Some of the points brought out by the foregoing tables may be stated as follows:—

(1) In proportion to population, the United States has more than twice as many students of university standard as are in England; Scotland has more than three times as many; and Germany nearly three times as many.

(2) There are only 5000 full-time students of science and technology in the United Kingdom in comparison with nearly 17,000 in Germany and 34,000 in the United States.

(3) The total income of universities in the United States amounts to about 20,000,000*l.*, and that of Germany to nearly 1,800,000*l.* The total income of all the universities of the United Kingdom is about 2,000,000*l.*

(4) Eighty per cent. of the total income of German universities is derived from State grants, in comparison with 34 per cent. contributed in Parliamentary grants to the modern universities of England and Wales.

(5) Thirty per cent. of the income of universities in the United States is derived from invested funds and donations, in comparison with 15 per cent. in the modern universities of England and 6 per cent. in those of Wales.

(6) The tuition fees at universities of the United Kingdom form a much higher percentage of the total income than they do in the United States and Germany.

(7) Nine universities in the United States have individual incomes exceeding the total amount granted annually by Parliament to universities and institutions of like standard in the United Kingdom.

(8) Five States of the United States give grants to their universities exceeding the amount of the Parliamentary grants to universities and colleges of England and Wales.

(9) Private benefactions to universities and colleges in the United States amount to more than 5,000,000*l.* annually; in the United Kingdom they do not average one-twentieth that sum.

(10) The colleges of agriculture and mechanic arts in the United States have a total income of 7,000,000*l.*, or ten times that of the whole of the modern universities of England and Wales.

(11) The University of Berlin receives annually from State funds a grant nearly equal to the total annual Parliamentary grants to the universities and colleges of England and Wales.

It will be evident from these facts that in the domain of higher education the United Kingdom compares very unfavourably with the United States and Germany. No doubt one reason for this is that in America and Germany there has been a greater demand for highly trained men than in the British Isles, where posts for such men have been few, salaries low, and prospects poor. Conditions are, however, improving; and the industrial research associations being formed in connection with the Department of Scientific and Industrial Research, as well as associations established on the lines suggested by the Whitley Report, need for their successful operation the employment of men capable of undertaking research. The conditions of industrial development and the competition of other countries make it essential to secure an adequate supply of trained workers of this type.

Increased grants to universities and technical institutions are needed to enable the tuition fees to be reduced and to ensure that the staffs are paid salaries commensurate with the high qualifications demanded. The present aid given by Parliament is in no way adequate to modern needs, and compares very unfavourably with what is available in the United States and Germany. The grand total of all Parliamentary grants to universities and technical colleges of university rank in the United Kingdom is about 500,000*l.*, whereas the Federal and State grants in the United States amount to 7,000,000*l.*, and in Germany to nearly 2,000,000*l.* The provision made by Parliament for higher education is thus obviously not that which should be expected of a State which intends to maintain its position among leading Powers. R. A. GREGORY.

SCIENTIFIC ORGANISATIONS OF THE ALLIED NATIONS.

At the invitation of the Royal Society, a conference between representatives of the Allied nations will be held in London on October 9 to discuss the future conduct of scientific organisations. It is expected that representatives from the academies of Paris, Rome, Tokyo, and Washington, as well as nominees of the Governments of Belgium, Portugal, and Serbia, will attend. A memorandum proposed by a committee of the Royal Society points out that international scientific organisations and conventions may be divided into four groups, according to their objects and methods of procedure. A first group consists of those important agreements which fix the standards of measurements, and are essential not only in purely scientific investigations, but also in the development of many industries. A second group contains associations definitely formed for the investigation of scientific problems in which co-ordination of observation is essential. A third group, which hitherto has not been large in numbers, but presents some special features, embodies the efforts to organise undertakings that might be carried out in one locality, but is more economically dealt with by a division of work. The most prominent example of this type is the arrangement made between eighteen observatories to form a photographic chart of the heavens. The organisation dealing with the "International Catalogue of Scientific Literature" may also be included in this group. In the fourth group is placed the large number of congresses called together by workers in some one department of science, and mainly intended to foster friendly personal relationships between those who pursue similar aims in different countries. There is, finally, in a group by itself, the International Association of Academies, which aims at co-ordinating the activities of international undertakings, and organises work for which special permanent bodies do not exist and are not required. The council of the Royal Society will submit the following questions as subjects for discussion at the forthcoming conference:—(1) Is it desirable for the Allied nations to establish organisations for scientific co-operation among themselves? (2) If this be agreed upon, what should be the particular forms of organisation to be aimed at in geodesy, seismology, meteorology, etc.? (3) Should particular academies be asked to submit proposals on those undertakings in which they have taken the leading part, such as: (*a*) The Académie des Sciences on the Commission Métrique and the Bureau International des Poids et Mesures; (*b*) The Royal Society on the International Catalogue of Scientific Literature? (4) What representations should be addressed to the Governments with regard to those organisations which have hitherto received their support? The conference at present is intended to deal only with scientific subjects, but similar questions no doubt also arise on the literary side.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn from the *Times* that Prof. J. J. Findlay, professor of education in the University of Manchester, has accepted the invitation of the Y.M.C.A. Universities' Committee to become its director of education in Salonika, where it is hoped that an extensive system of classes and lectures will be developed during the autumn and winter. Prof. Findlay will leave for Salonika in September. To the work on the lines of communication in France which Sir Henry Hadow has undertaken for the committee will now be added similar service among the British troops in Italy.

THE governors of the Royal Technical College, Glasgow, have appointed Dr. C. H. Desch to the chair of metallurgy in the college, rendered vacant by the resignation of Prof. A. Campion. Dr. Desch received his scientific training at the Finsbury Technical College, at Würzburg University, and at University College, London, under the late Sir William Ramsay. After eight years' practical experience as chemist in a chemical works, he was for five years research assistant to the professor of metallurgy in King's College, London; for the last ten years he has been Graham Young lecturer in metallurgical chemistry in Glasgow University.

THE Education Act received the Royal Assent on August 8, and is now, therefore, on the Statute-book. The following is a summary of the main changes in the provision of public education in England and Wales as given in the *Times* of August 9:—(1) No exemptions from attendance at school shall be granted to any child between the ages of five and fourteen. (2) Local authorities may increase the age of compulsion by by-law to fifteen. (3) Compulsory day continuation schools shall be established for all young persons, unless they are being otherwise educated, up to the age of sixteen, and after seven years from the appointed day up to the age of eighteen. (4) The minimum number of hours of attendance at continuation schools shall be 280, and after seven years 320. (5) No child under twelve shall be employed. (6) No child between twelve and fourteen shall be employed for more than two hours on any Sunday, or on any school day before the close of school hours, or on any day before 6 a.m. or after 8 p.m. Exceptions may be made by by-law, provided that no child may be employed for more than one hour before school, and if so employed, for more than one hour in the afternoon. (7) Local authorities may make provision for the supply or maintenance of holiday or school camps, centres for physical training, school baths, swimming baths, and other facilities for social and physical training. (8) Provision is made for the medical inspection and treatment of pupils in secondary and continuation schools. (9) Local authorities may establish nursery schools for children between the ages of two and five. (10) Special schools are to be established for physically defective children. (11) Fees in public elementary schools are abolished.

REPRESENTATIVES of the various Government Departments at Washington have recently held a number of conferences to consider, in response to the numerous requests of school officials, what American schools should do to render the utmost service of which they are capable during the war emergency. The conclusions and recommendations resulting from these conferences are now published in the form of a leaflet for distribution to American teachers by the Washington Bureau of Education. So far as elementary schools are concerned, the representatives decided that there appears to be nothing in the present or prospective war emergency to justify curtailment in any respect of the sessions of these schools, or of the education of boys and girls under fourteen years of age, and nothing which should serve as an excuse for interference with the progressive development of the school system. It is suggested, however, that school activities with an educational value might be introduced, designed to connect the schools with the ideals of service and self-sacrifice actuating the American people. In the case of secondary schools it is suggested that much valuable service could be rendered by selecting and training boys to assist in meeting the need for agricultural labour. It would be helpful in industrial communities if, for secondary-school pupils above fourteen, definite courses could be introduced looking towards a co-operative half-time plan of school attendance and employment throughout the year. Boys and girls should be urged, American teachers are being told, to remain in school to the completion of the high-school course, and in increasing numbers to enter upon college and university courses, especially in technical and scientific lines, to meet the great need for trained men and women.

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, July 8.—Dr. J. Horne, president, in the chair.—Dr. R. **Kidston** and Prof. W. F. **Lang**: Old Red Sandstone plants, showing structure, from the Rhynie chert bed, Aberdeenshire. Part ii. Additional notes on *Rhynia Gwynne-Vaughani*, Kidst. and Lang; *Rhynia major*, n.sp.; and *Hornea Lignieri*, n.gen. et sp. In this paper the species of Rhynia, which were included under one name in a former account, are distinguished as *R. Gwynne-Vaughani* and *R. major*. The latter plant is larger in all its parts, and lacks the adventitious branching found in *R. Gwynne-Vaughani*; but its morphology is essentially similar. Both plants are rootless and leafless. They have a subterranean rhizome with a simple stele, erect branched cylindrical shoots, and terminal sporangia. Another plant of similar organisation is named *Hornea Lignieri*, and is united with Rhynia in the family Rhynaceæ. It also had neither roots nor leaves. The subterranean rhizome was protocormus-like, and from it erect dichotomous stems arose. At the tips of some of these were developed sporangia, which differed from those of Rhynia in having a columella of sterile tissue, making the spore-sac dome-shaped.—A. G. **Ramage**: Notes on mirage observed on the Queensferry Road. Under the conditions of a strong sun and not too strong a breeze, apparent reflections of grass and passing vehicles were observed in the highly heated surface of the bitumenised road. It was necessary to stoop so as to bring the mirage phenomenon over the surface into view. Sometimes a silvery streak was observed. The author did not find the usual theory of mirage sufficient, and suggested the reflection from a swarm of small particles as a *vera causa*.—Dr. W. W. **Taylor**: (1) The rotatory commutator method of determining electric conductivity, and an improved form of MacGregor's drum. This drum is a double reversing key, reversing the current continuously so as to make it alternating through the electrolyte, and readjusting it so as to make it continuous through the galvanometer. It is well known that with the usual form of drum the apparent resistance varies with the conditions, such as the rate of rotation, and differs slightly from the value obtained by the Kohlrausch method. These defects are due to the construction of the drum, and by a simple modification the defects have been overcome. (2) The solubility of "insoluble salts" and of silver oxide. There are large discrepancies between the solubility of these substances as determined by chemical analysis and physical methods, the latter depending on the determination of the concentration of an ion. The chemical methods give always the greater values, owing to the presence of "sols" of the substance in addition to the true solution. In the case of silver oxide a yellow-brown solution was on one occasion obtained; yet its total amount was less than in a similarly prepared colourless solution. In like manner, the increased solubility of insoluble salts in presence of substances like starch is to be attributed to the protection of the sol by the emulsoid, and not to adsorption at the interface. (3) The electric conductivity of sols. A series of determinations of the electric conductivity of Kohlschütter's silver sol led to the conclusion that the small limiting conductivity is dependent on the electrolyte "impurity" derived from the substances employed in the preparation of the sol. (4) The titration acidity of urine. The estimation of the acidity of urine by titration with alkali and phenolphthalein: potassium oxalate is added "to remove the calcium which interferes with the end-point." Experiments show that the end-point is the same in the absence of the oxalate, though perhaps it is not quite so easily fixed. The addition of neutral calcium chloride is found to increase the acidity to a certain definite extent, and this increased acidity is removed by neutral potassium oxalate. It has not yet been ascertained to what constituent of the urine this is due.—R. A. **Fisher**: The correlation of relatives on the supposition of Mendelian inheritance. The general conclusions of this mathematical investigation are:—(1) The facts of biometry do not contradict, but in many cases positively support, the theory of cumulative Mendelian factors; (2) if the theory is correct, a sufficient knowledge of the correlation coefficients for any one feature, between different pairs of relatives, would enable us to analyse completely and estimate numerically the percentage due to heritable factors; (3) a provisional examination of the existing data shows it to be quite unlikely that more than 5 per cent. of the variance of the physical measurements of man is due to non-heritable causes.

PARIS.

Academy of Sciences, July 22.—M. P. Painlevé in the chair.—G. **Bigourdan**: The observatory of the Luxembourg. An account of Delisle's work and instruments, 1712–15 and 1722–25.—H. **Douvillé**: Are the foraminifera unicellular? From the evidence given it appears that certain foraminifera are in the first phases of their quadri- or bi-cellular development.—E. **Leclainche**: Serotherapy in gas gangrene. Historical account of the use of polyvalent sera against gas gangrene in France.—W. W. Campbell was elected a correspondant for the section of astronomy in succession to the late Dr. Auwers, and G. Lecointe a correspondant for the section of geography and navigation in succession to the late Dr. Helmert.—R. **Jonckheere**: Discovery of the periodic comet of Max Wolf. This was found at Greenwich on July 9 as a small nebulosity about 9″ diameter and of the 15th or 16th magnitude. The difference between the calculated and actual positions of the comet was much greater than was the case with previous appearances.—J. **Renaud**: Deep ports on French ocean and Channel coasts. Approaches to ports should be at least twelve metres deep at low water. Positions satisfying this condition are rare on the French coasts, but exist at Brest, Pallice, and Cherbourg.—P. **Girault**: A particular case of distribution of the current between transformer coils coupled in parallel.—L. **Tschugaeff**: The acid function of osmium tetroxide. Osmium tetroxide gives a series of well-defined compounds with the hydroxides of potassium, rubidium, and cæsium of the general formula $2MOH.OsO_4$. This is in opposition to the current view that osmium tetroxide is devoid of acid properties.—A. **Valeur**: A new volatile alkaloid from the broom. This was isolated from the mother-liquors from the recrystallisation of commercial sparteine sulphate. The name "genisteine" is proposed for the new base, and methods of separating it from sparteine are described. Its composition is $C_{16}H_{28}N_2$, and the properties of its hydrate, picrate, chloroplatinate, and chloroaurate are given.—M. **Stéphanidès**: Greek fire or the "liquid fire" of the Byzantines. The view is put forward that Greek fire was a crude petroleum.—H. **Hubert**: Geology of the north of the Senegal.—P. **Garrigou-Lagrange**: The general movements of the atmosphere. An application of the kinematograph to the study of meteorological charts.—F. **Maignon**: Comparative study of the influence of carbohydrates and fats on the nutritive power of alimentary proteids. Experiments on white rats show that albumin is better utilised with fat than with starch. It follows from these experiments that fats play an important part in the utilisation of proteid materials.—J. **Legendre**: The biology of *Eleotris goboides*.—V. **Galippe**: New researches on the presence of living elements in normal muscular tissue (normal parasitism and microbiosis).

WASHINGTON, D.C.

National Academy of Sciences (Proceedings, vol. iv., No. 1), January, 1918.—H. P. **Armsby**, J. A. **Fries**, and Winfred W. **Braman**: The basal katabolism of cattle and other species. The results show that the basal katabolism of different species is substantially proportional to their body-surface.—F. H. **Seares**, A. van **Maanen**, and F. **Ellerman**: The location of the sun's magnetic axis. In extension of the work of George E. Hale, a large number of observations were undertaken to determine the position of the sun's magnetic axis, which is found to lie near the axis of rotation at an inclination of about 6°, and to revolve about the axis of rotation in about thirty-two days.—J. T. **Tate** and P. D. **Foote**: Resonance and ionisation potentials for electrons in cadmium, zinc, and potassium vapours. The results agree within the limits of experimental error with the values as calculated from the quantum relation $h\nu = eV$, where ν is the frequency of the single radiation in the case of resonance potentials or the limiting frequency of the series of radiations in the case of ionisation potentials.—E. H. **Hall**: The validity of the equation $P = dv/dT$ in thermo-electricity. The equation is known to be unverified experimentally. The author gives a brief, critical discussion of the validity of some theoretical proofs by which the equation has been deduced.—C. **Barus**: The equations of the rectangular interferometer. A discussion under the headings of: Auxiliary Mirror, Rotating Doublet, Ocular Micrometer, and Collimator Micrometer.—S. **Hatai**: The brain-weight in relation to the body-length, and also the partition of non-protein nitrogen in the brain of the grey snapper (*Neomaenis griseus*).—F. G. **Pease**: The rotation and radial velocity of the central part of the Andromeda nebula. The radial velocity -316 km. is found. The change of rotational velocity with distance from the centre seems to be linear.

(Proceedings, vol. iv., No. 2), February, 1918.—G. N. **Lewis**, E. D. **Eastman**, and W. H. **Rodebush**: The heat capacity of electro-positive metals and the thermal energy of free electrons. The experiments go to indicate that in the metals considered the difference between the heat capacity observed and that calculated may be regarded as representing the actual heat capacity of the more loosely bound electrons in these metals.—E. H. **Hall**: Thermo-electric diagrams on the P-V-plane. An analysis of the electromotive force of a thermo-electric circuit on the assumption that the "free" electrons within the metals are the only ones moving progressively in the maintenance of a current, and the only ones taking part in thermo-electric action.—G. **Stromberg**: A determination of the solar motion and the stream motion based on radial velocities and absolute magnitudes. The stream motion is probably a local effect caused by a preferential motion of the stars in both directions around the centre of the stellar system. There appears to be a tendency towards smaller values of the declination of the sun's apex for the intrinsically faint stars.—L. R. **Jones**: Disease resistance in cabbage. In every case the selected head-strains transmitted in considerable degree their resistant qualities, and certain of them did so in high degree. A discussion of the results in their general significance is also given.—L. **Page**: Is a moving star retarded by the reaction of its own radiation? An extended analysis of the forces acting upon the electron leads to the conclusion that the moving electron, and hence any moving matter, suffers no retardation through its motion.—S. J. **Barnett**: Electromagnetic induction and relative motion. II. The experiments appear to support the hypothesis for the existence of the æther, and to be inconsistent with the principle of relativity.

(Proceedings, vol. iv., No. 3), March, 1918.—F. **Payne**: The effect of artificial selection on bristle number in *Drosophila ampelophila* and its interpretation. There are at least two factors for extra bristle number, one of them located in the first and one in the third chromosome.—A. W. L. **Bray**: The reactions of the melanophores of Amiurus to light and to adrenaline. The melanophores in the skin of the Amiurus react to direct stimulation by adrenaline, and are subject to nervous control mediated through the eye.—J. **Loeb**: Further experiments on the sex of parthenogenetic frogs. The frogs produced by artificial parthenogenesis can develop into adults of full size and entirely normal character.—E. **Dershem**: The resolving powers of X-ray spectrometers and the tungsten X-ray spectrum. The theory of resolving power is given with the results of experiments on tungsten, in which the endeavour was made to obtain as high a resolving power as possible.—C. **Barus** and M. **Barus**: Note on methods of observing potential differences induced by the earth's magnetic field in an insulated moving wire. A simple apparatus is described, and an elementary estimate first given. The apparatus was then modified, producing intensification, and new observations were made.—C. D. **Perrine**: Dependence of the spectral relation of double stars upon distance. There is an indication that some external cause is operating in more or less definite regions of our stellar system upon the conditions which produce spectral class.—C. D. **Perrine**: Hypothesis to account for the spectral conditions of the stars. The spectral condition of a star depends chiefly upon its size and mass, and the external conditions of density of cosmical matter and relative velocities of star and matter.

BOOKS RECEIVED.

Australasian Antarctic Expedition, 1911–14. Scientific Reports. Series C. Zoology and Botany. Vol. v., Part 2. Brachyura. By M. J. Rathbun. Vol. v., Part 3. Copepoda. By Dr. G. S. Brady. Vol. v., Part 4. Cladocera and Halocypridæ. By Dr. G. S. Brady. (Sydney: W. A. Gullick.) 1s. each.

Ingots and Ingot Moulds. By A. W. and H. Brearley. Pp. xv+218. (London: Longmans and Co.) 16s. net.

CONTENTS. PAGE

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, AUGUST 22, 1918.

SIR JOSEPH HOOKER.

Life and Letters of Sir Joseph Dalton Hooker, O.M., G.C.S.I., Based on Materials Collected and Arranged by Lady Hooker. By Leonard Huxley. Vol. i., pp. x+546; vol. ii., pp. vi+569. (London: John Murray, 1918.) 2 vols., price 36*s*. net.

AMONG the books whose claim on our attention is relatively independent of accidental considerations like timeliness or style, none surpass in interest those that deal with revolutions in human thought. Among revolutions of this kind none have been more important than the one which led to the replacement of the dogma of specific immutability by a more satisfying thesis. The doings and sayings of the men whose minds first proved receptive of this vivifying doctrine inspire in scientific circles feelings akin to those induced elsewhere by hagiologic studies.

The story of the life of Sir Joseph Dalton Hooker, whom Prof. Bower happily designates the "protagonist of evolution," is on this account a contribution of great moment to the history of a period and a movement already illustrated by those of the lives of Lyell, Huxley, Wallace, and especially of Darwin. It rounds off in many ways information already available with regard to a notable advance in human thought, and supplements the material required for that ordered review of a great scientific achievement much needed by the present generation. "The imperfect conceptions of some of its favourers" are as noticeable to-day as they were to Hooker a generation ago; they are only less inimical to a true understanding than were the conceptions of many of its opponents a generation earlier still. There is a distinction between the situation then and the position now. Sixty years ago imperfection of conception was often the result of inability to appreciate what was then a novel doctrine; to-day this imperfection is largely due to neglect to consult the writings in which that doctrine was promulgated.

Readers of NATURE have already been supplied (December 21, 1911) with a sketch of the leading features of Hooker's career, and a generation earlier (October 25, 1877) with an appreciation, by a singularly competent judge, of the work already done by Hooker, and of the position he occupied in contemporary opinion at the height of his career. The tale, worthy of recapitulation though it be, it is not necessary to repeat. The story is fully given in two volumes, now published by Mr. Murray, which should be even more interesting to readers already acquainted with the leading facts of Hooker's long and active life than to those as yet unfamiliar with the subject. Among Hooker's many gifts was the possession of a pleasing style, and those to whom his published works are known will find that this style is as effective in the letters now made available and as happy in his correspondence with the young as in his epistles to the mature. All will welcome the informed and penetrating estimate by Prof. Bower of the position of Hooker as a philosophical student. The work under notice is of further value as a human document. It is no mere chronicle of what Hooker did and how he did it. Thanks to the labours of Lady Hooker and the craftsmanship of Mr. Huxley, these volumes permit the general reader to form some conception of what Hooker was as a man.

His innate modesty led Hooker to claim for himself but one natural endowment, "le talent de bien faire." Even to the possession of this spur to sustained effort he did not publicly confess until it fell to him to acknowledge the receipt, in his seventieth year, of the highest honour his scientific fellow-countrymen could bestow. The same simplicity marked his expression of the feeling evoked by what he has termed the crowning honour of his long life, "as inestimable as unexpected," conferred upon him, twenty years later, in circumstances of peculiar dignity, by the Swedish Academy of Sciences.

No enumeration of the honours of which Hooker was the recipient—no recital of what he accomplished to merit them all—can explain the esteem and respect in which he was held. The simple nature which led him to regard praise with repugnance made it impossible for Hooker to become "popular" in the sense in which that term is usually understood. With him, indeed, the intellectual aversion induced a physical reflex. The mere anticipation of the ordeal of appearance in public led in his case to actual illness, the effects of which sometimes persisted when the ordeal was over. But it was the mental dislike, not the bodily inconvenience, that rendered so rare the participation by Hooker in great debates. Where intervention was plainly necessary Hooker never failed his friends or their cause; the "talent" the existence of which he admitted explains why such intervention, when it did occur, proved so effective.

We learn from this work how deeply Hooker was indebted to his distinguished father. If not exactly born in the purple, he certainly was made to that purple he wore so worthily. The development of his natural aptitudes, the early provision of opportunities for their independent exercise, keen solicitude for his welfare, and anxious care for his interests—all were matters of paternal concern. This regard Hooker repaid by a filial piety as warm at the close of his life as it had been in boyhood, and as it was when he served as his father's tried coadjutor. Reverence for his father's memory and regard for his father's fame gave Hooker inward support during official controversy; led him to continue, after his own retirement, publications his father had edited; and prompted him to undertake, at the age of eighty-five, a finished study of his father's achievements.

The capacity for comradeship and the self-effacing consideration for others which marked this relationship between father and son were natural characteristics. The former was seen in that association with T. Thomson, begun at school, which led to the production of that noble fragment, their "Flora Indica." It is illustrated again in that copartnery with Bentham initiated while Hooker was bearing, unaided, the burden of his directorship, which led to the completion before Hooker retired of that masterly work, the "Genera Plantarum." A striking instance of that self-abnegation which induced Hooker to take from the hands of fellow-workers who had fallen by the way tasks left by them unfinished is seen in his compliance, at a time when his hands were full to overflowing with duties of his own, with the dying wish of Harvey that he should arrange the materials that distinguished botanist had prepared for a second edition of the "South African Genera." A generation later, undaunted by the weight of his eighty years, Hooker wrote two volumes needed to complete a "Flora of Ceylon," whereof only three had been published when Trimen died.

Hooker's distaste for popular applause was untinged by any disinclination for intercourse. However busy he might be, no one, young or old, whose errand was serious, ever was turned away. The soul of hospitality, he was also eminently sociable, though he regarded as essential for social intercourse "some place where we never should be disappointed of finding something worth going out for." When he felt that by so doing he could render real service, he was ready, in spite of his natural reluctance, to undertake those public duties that public men, situated as he was, are expected to perform.

Throughout his life Hooker exercised on contemporary work and thought an influence that was wholly good. The diversity of his interests, the extent of his knowledge, the soundness of his judgment, and the singleness of his purpose explain the value of that influence. Generous of praise where praise was due, he was also, much to the advantage of younger workers, unsparing of blame where blame was deserved. The distinction between Hooker's commendation and his censure lay in this, that work well done by others was to him an abiding memory, but that when a delinquent had been "faithfully dealt with" the delinquency was consigned to oblivion. The affectionate regard in which he was held by younger men may be understood. The admiration of those nearer him in age is as readily explicable. Second to none in the accuracy of his observation, and endowed as few have ever been with the inborn faculty of co-ordination, Hooker possessed in addition one of the rarest of capacities: he remained, throughout his life, free from the thrall of that barrier to progress and foe to intellectual development, a craving for formal consistency.

But what is perhaps most remarkable in the life of Hooker is the circumstance that his influence, in a country such as ours, should have been as great as it deserved to be. The reason for this is to be found in his magnetic personality. It has been the lot of few men to possess so many friends as Hooker did; fortune has given no man friends more faithful. These friendships were too numerous for census here. Their origin may be traced in every case to some community of interest, yet the common interest out of which they grew was by no means always botanical—one of the warmest was that between him and Henry Yule, of "Hobson-Jobson" fame. Some of these associations, like those with Paget and T. Thomson, dated from boyhood; others, like those with Charles Darwin and Asa Gray, began after his return from the Antarctic; others, again, like those with Falconer and Hodgson, went back to his days in India. The faculty remained unimpaired by time; Hooker's "troops of friends" enrolled recruits to the last. What such friendships implied we may measure best by reading the letters exchanged by Hooker with Darwin and Huxley; the genesis of one of the closest is disclosed in the home letters written by Gray while on his first visit to Europe. "The Life and Letters of Sir Joseph Dalton Hooker" is "dedicated to the memory of many friendships." No more fitting superscription could well have been devised for Mr. Huxley's volumes than that approved by Lady Hooker.

TYCHO BRAHE'S STUDIES OF COMETS.

Tychonis Brahe Opera Omnia. Tomi Quarti, Fasciculus Prior. Pp. 376. (København: Gyldendalske Boghandel, 1918.)

As some documents intended to appear in vol. iv. of the collected works of Tycho Brahe are inaccessible owing to the war, the volume has been divided into two portions, of which the first has just been published. It contains the treatise "De Mundi Ætherei Recentioribus Phænomenis," which was printed at Uraniborg in 1588; this deals mainly with the comet of 1577, which was the brightest of the seven comets that appeared during Tycho's career as an observer; his observations of it sufficed definitely to dispel the Aristotelian doctrine, which Tycho had himself held up to that time. Thus in writing of the nova of 1572, and comparing it with Hipparchus's nova, Tycho said: "It would be absurd to fancy that a great astronomer like Hipparchus should not have known the difference between a star of the ethereal region and a fiery meteor of the air, which is called a comet." However, his principles were to take nothing on trust from ancient authorities, but to submit theory to the test of careful observation, excepting the case of the solar parallax, for which he used the received value of $3'$, though his instruments were capable of showing that the true value was much smaller.

When a very bright comet appeared in 1577 Tycho naturally took advantage of it to endeavour to determine the nature and orbits of these bodies. The book describes his first observation of the comet. On the afternoon of November 13 he was engaged in fishing with some of his assistants. Looking up to the western sky, to see the prospects for observation that evening, he saw a bright object, and pointed it out to the assistants, who took it for Venus; but Tycho said that was now a morning star, and that after sunset they would see the difference; in fact, when it became dark a tail, 22° in length, was seen stretching across Capricornus, the head being in Sagittarius. Tycho was not the first to see it; it had been seen on November 1 in Peru, and on November 2 in London. His observations were, however, much the most accurate that were made; he measured its distance from neighbouring stars with a sextant, the arms of which were 4 ft. long, afterwards observing the places of the stars with his fundamental instruments. He followed the comet until January 26, when it was in Pegasus. He examined its diurnal parallax both by his own observations at different hours of the night and by comparing his places with those observed at Prague by Hagecius. He was thus enabled to say definitely that the comet was considerably more distant than the moon, and consequently the Aristotelian doctrine that comets are simply atmospheric meteors was completely overthrown.

Tycho's endeavours to determine the true orbit were not very successful. He was still under the influence of the old prejudice that all the heavenly movements must necessarily be in circles, and the orbit he assigned to the comet was a circular one, with the sun in the centre, and a radius about six-sevenths of the distance from sun to earth, giving an angle of elongation of 60°. Tycho was unable, however, to represent the observations by uniform motion in this circle. He deduced correctly that the heliocentric motion was in the opposite direction to that of the planets, and supposed that comets were short-lived bodies, the movements of which might be subject to greater irregularities than those of the planets. The inclination of the orbit to the ecliptic he gave as $29\frac{1}{4}°$, about one-third of its true value; it is interesting to quote the parabolic orbit (based on Tycho's own observations) for comparison with his: Perihelion passage, October 27; long. of asc. node, 25°; arc from node to perihelion, 256°; inclination, 105°; perihelion distance, 0·177. It is not surprising to read that many of Tycho's contemporaries did not perceive the force of his proof that the comet was much more distant than the moon, and continued to assert the Aristotelian doctrine. Among them was a Scotsman named Craig, with whom Tycho had a long controversy.

The volume also describes Tycho's system of the universe, and his reasons for adopting it. He thought the earth was too heavy and sluggish a body to be capable of rapid motion, and he also thought the absence of a lateral drift in falling bodies disproved the theory of its rotation. He therefore supposed it to be at rest in the centre of the universe, and that the sun and moon revolved round it, while the planets revolved round the sun. The fixed stars were imagined to be attached to a transparent sphere a short distance beyond the orbit of Saturn; at least, this is suggested by his diagram, which pictures them as all lying between two closely adjacent concentric spheres, and by his supposition that they rotate *en bloc* about the earth in twenty-four sidereal hours. He thought the absence of annual parallax in the stars afforded a decisive proof of the earth's immobility, and the idea of the immense void of space between the orbit of Saturn and the stars, which would be required on the hypothesis of the earth's motion, was repugnant to his mind. Also he considered that he had determined the apparent diameters of the brighter stars to be 2′ or 3′, and he saw that such diameters, in view of the absence of annual parallax, implied dimensions for these orbs that he regarded as inconceivably great. It must be admitted that before the invention of the telescope and the discovery of the laws of motion and gravitation there was a good deal to be said for his point of view, and he did not permit his theory to bias his observations, which enabled Kepler to deduce the true planetary system.

These sumptuous volumes, though printed at Copenhagen, are edited by Dr. Dreyer, who now resides at Oxford. They enable us to picture the astronomical conceptions of Tycho's age, and the enormous progress that has been made in the last three centuries. A. C. D. CROMMELIN.

OUR BOOKSHELF.

Natural Science and the Classical System in Education. Essays New and Old. Edited for the Committee on the Neglect of Science by Sir Ray Lankester. Pp. ix+268. (London: William Heinemann, 1918.) Price 2*s.* 6*d.* net.

FOUR of this admirable series of nine essays were written fifty years ago, but they are wonderfully fresh and stimulating even now. These include a masterly history of classical education by Charles Stuart Parker, and essays "On the Education of the Reasoning Faculties," by William Johnson, the brilliant Eton tutor of the later nineteenth century; "On Teaching by Means of Grammar," by E. E. Bowen, of Harrow, of "Forty Years On" renown; and "On the Present Social Results of Classical Education," by Lord Houghton, father of the present Marquess of Crewe.

The views of Mr. H. G. Wells on modern education, as set out in an address to the members of the British Science Guild, are reprinted in this volume; and readers of the *Fortnightly Review* will recognise the same author's "Case against the Classical Languages," written in reply to Mr. Livingstone's "Defence of Classical Education."

The position of science in educational reconstruction is discussed by Mr. Sanderson, of Oundle School, in an essay which will probably meet with criticism from some educationists. The Master of Balliol has treated the same question in its wider aspects. Sir Ray Lankester concludes with a chapter on "The Aim of Education," throughout which runs the spirit of Huxley.

Nowhere is there any suggestion of antagonism towards the study of the classics; indeed, all scientific workers realise to the full the value of classics as a branch of education. The monopoly of the classical system in education, however, is a different matter, and this dominating factor is assailed on all sides.

Horizons: At Dawn and at Dusk. Poems by Colin Tolly. Pp. ix+82. (London: Hodder and Stoughton, 1918.) Price 3s. 6d. net.

Mr. Tolly is clearly a scholar who has been thrown, like so many others, into the brutalities of war, and who heartens himself by writing verses that recall the happier years. But, though he has studied the ancient classics, and also zoology, his manner is not that of a poet, or even of a teacher, seeking in the concise forms of verse the expression of cumulative research. Why, for example, and for what mechanical reason, did the dead Adonis sail "to sea, on springs"? Does the sun "shine" a beam? And will the general reader, who has still so much to learn about ancestral forms of life, really gather anything from the condensed text-book terminology of pp. 49–60? We might, indeed, be pleasantly surprised to "hear the tune" that the Permian reptiles "sang at sundown . . . pregnant with speech and nightingales"; but we cannot believe that, by any process of selection, "Death . . . endowed with brains the victors" in the struggle for existence. The crowded stanzas on the development of religions are not more satisfactory. It is unfair to suggest what Swinburne or Flecker might have made of them; but, even between Olympos and Salonika, Mr. Tolly has caught only the spray of the high and rising wave of war-time inspiration.

G. A. J. C.

Journal of the Institute of Metals. Vol. xix. Pp. x+316. (London: Published by the Institute, 1918.) Price 21s. net.

The latest volume of this useful journal contains several papers of interest. Prof. Carpenter, in addition to his presidential address, in which he deals with the relations between scientific investigation and training and technical practice, contributes, with Miss Elam, a paper on the cause of unsoundness in bronze castings. The subject is a difficult one, and the principal conclusion, confirmed by the experience of others who took part in the discussion, is that the most important factor in ensuring soundness is the proper control of the pouring temperature. The equilibrium between a molten alloy and the gases dissolved in it still remains somewhat mysterious. Die-casting, especially of alloys of high melting-point, has received little attention in technical journals, although it is widely and successfully used in practice, and the paper by Messrs. Rix and Whitaker is the more welcome on that account. By using an aluminium bronze containing iron, excellent results have been obtained with complicated castings. The discussion turns largely on the behaviour of the dies. Aluminium bronze is also studied from the point of view of the hardness of alloys by Mr. Greenwood, and other matters dealt with are the determination of the grain size of metals and the annealing of aluminium. The volume also includes abstracts of metallurgical papers from all sources.

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.*]

Science and the Civil Service.

In the article on the above subject in Nature of August 8, the unsatisfactory method of selecting candidates for Civil Service appointments is very justly emphasised. I desire to make the following suggestion, which will obviate the system of patronage and to a great extent that of competitive examination, both of which suffer from serious inherent defects which need not be discussed.

My suggestion is that each university of the United Kingdom be granted the right to nominate each year one or more candidates (according to the number of vacancies) from its most promising honours graduates. A further selection from among the nominees might, if necessary, be made by some form of oral or written examination.

It is improbable that any university would abuse this privilege and thereby discredit itself by nominating a student who is likely to prove a failure. The experience in the selection of the 1851 Exhibition scholars is a sufficient guarantee of the highly satisfactory results of such a system.

The most promising arts and science men in the country would thus become available for Government appointments, and it is to be hoped that with this choice the science departments of the State will in future be administered by men whose training has not been exclusively classical.

J. B. Cohen.

THE ROYAL INSTITUTION: A RETROSPECT.

A recent issue of the Proceedings of the Royal Institution contains a reprint of a lecture delivered in its theatre on March 3, 1810, by the then professor of chemistry, "H. Davy, Esq., Sec., R.S." This lecture, as its title-page informs us, was originally published by desire of the managers; it is now reproduced at the suggestion of the Fullerian professor of chemistry. It is entitled "A Lecture on the Plan which it is Proposed to Adopt for Improving the Royal Institution and Rendering it Permanent." To understand the significance of this wording it is necessary to recall some circumstances connected with the early history of the institution.

As conceived by its founder, Benjamin Thompson, a Royalist American who had been created a Count of the Holy Roman Empire by the Elector Palatine of Bavaria, it was intended to be part of an establishment for the benefit of the poor. In 1796 Rumford, who was a practical philanthropist on a pretty broad gauge, and an early worker in what is now styled "domestic science," put forth a

proposal for forming in London by private subscription an establishment for feeding the poor and giving them useful employment, and also for furnishing food at a cheap rate to others who may stand in need of such assistance, connected with an institution for introducing and bringing forward into general use new inventions and improvements, particularly such as relate to the management of heat and the saving of fuel, and to various other mechanical contrivances by which domestic comfort and economy may be promoted.

Rumford, as he says in one of his letters to Thomas Bernard, who was associated with him in this project, was

deeply impressed with the necessity of rendering it *fashionable* to care for the poor and indigent.

A "Society for Bettering the Condition of the Poor" was duly founded, but as regards the associated institution it was decided that it would be

too conspicuous, and too interesting and important, to be made *an appendix* to any other existing establishment, and consequently it must stand alone, and on its own proper basis.

In 1799 Rumford again broached the subject of his institution for promoting domestic comfort and economy, and conferred with the committee of the "Society for Bettering the Condition of the Poor" concerning the steps to be taken in order to establish,

by private subscription, a public institution for diffusing the knowledge and facilitating the general and speedy introduction of new and useful mechanical inventions and improvements; and also for teaching, by regular courses of philosophical lectures and experiments, the applications of the new discoveries in science to the improvement of arts and manufactures, and in facilitating the means of procuring the comforts and conveniences of life.

It is unnecessary to state the steps by which the sympathies of people of rank and fortune were enlisted in this enterprise. The moral, social, and political conditions of the time were not without their influence. The idea, as Rumford hoped, became fashionable, and, being fashionable, became popular. Mr. Mellish's house in Albemarle Street was secured as the future home of the institution, and its spacious apartments were quickly transformed into lecture-rooms, museums, library, and offices. Moreover, "a good cook was engaged for the improvement and advancement of the culinary art—one object, and not the least important—for the Royal Institution." The president of the Royal Society, Sir Joseph Banks, who had taken an active part in promoting its foundation, was chosen as the first chairman of its board of managers, Rumford became secretary, and Bernard treasurer. The second volume of the "Reports of the Society for Bettering the Condition of the Poor" contains a long account of the institution, "so far as it may be expected to affect the poor," from the pen of the treasurer, concerning which Dr. Bence Jones, a former secretary and the historian of the foundation, dryly remarks: "It is difficult to believe that the Royal Institution of the present day was ever intended to resemble the picture given of it in this report."

Although ushered into the world under such favourable auspices, the enthusiasm which greeted its birth quickly spent itself, and the infant institution had a struggling and precarious existence. The first appointments of the managers were not altogether fortunate. Rumford, by his arbitrary action, soon created difficulties and alienated powerful supporters. But the advent of Humphry Davy, a small, spare Cornish youth of twenty-three, was the turning-point in its career. On Garnett's resignation in 1801 as lecturer in chemistry, Davy, who had already given proofs of his ability, succeeded to that position. By his extraordinary and rapid success as an investigator, and by a series of discoveries which profoundly impressed the scientific world, combined with his eloquence and power as a lecturer and his remarkable gift of lucid exposition, he quickly changed the whole current of its fortunes, and during the twelve years he occupied its chair of chemistry he gradually stamped upon it the main features of its present character.

The theme of the lecture which the managers have now reprinted was not unfamiliar to Davy's audiences, for, although presented under the guise of a new plan, its general purport had been dealt with by him on several previous occasions. Its leading argument is, in fact, almost identical with that of the no less historic discourses with which he took the fashionable world of London by storm in 1802; and it was repeated in 1809 when he referred to the fund which had been raised to supply him with a powerful voltaic battery, and to which he again alludes with equal pleasure and appreciation in this reprinted address. But in the lecture of 1810 he enters, with his characteristic felicity of phrase, into rather more detail concerning what he considers to be the true function of the Royal Institution, and, on the basis of his ten years' experience of its working, indicates the means by which he considers its aims might be secured. Although he is careful to explain, with that tact and "flexibility of adaptation" which were among the secrets of his success in guiding the fortunes of the institution, that he is only to be regarded as an unofficial exponent of what he apprehends to be in the minds of the managers, visitors, and proprietors, his audience could have been in little doubt with whom the principles of the plan originated.

In 1810 it was fully realised that the continued existence of the institution depended upon Davy, and he certainly was not unconscious of that fact. He was then thirty-two years of age and near the summit of his scientific fame. But however proud the patrons of the institution might be of the achievements of their professor, and however grateful they might feel to him for the lustre he had conferred upon it, its financial position afforded no assurance of even a moderate provision for his future. He had become a social force in what he had styled "the great hot-bed of human power," and his society was courted by all. But the roseate vision of affluence which he had conjured up when exchanging the Pneumatic Institution of Beddoes for the Royal Institution of Rumford had been gradually dissipated in the fuller light of his knowledge of a position which depended upon the vagaries of fashion and the fickleness of popular favour. At this time he had serious thoughts of again turning to a career in medicine, for which, indeed, he was originally intended. It was practically the only career then open to a man of science unless he had the means of a Cavendish or a Banks.

Influential persons, moreover, who thought that Sydney Smith's lectures on moral philosophy would somehow better the condition of the poor, by dangling promises of preferment before him had sought to induce him to devote his eloquence and his talents to the service of the Church. But the little god that so often shapes the destinies of men and women had willed it otherwise. Unmindful of the injunction that a philosopher of another type and of a later age has crystallised in a phrase that has become classical, Davy succumbed to the fascination of a rich and handsome widow, who, as Sir Joseph Banks wrote to his friend Stanton, "had fallen in love with Science" and had elected to marry one of its votaries "to obtain a footing in the academic groves."

Although now within a social sphere very different from that into which he had been born, and to the attractions of which he was by no means insensible, Davy's heart was still true to the mistress that controlled his strongest inclinations and inspired his finest efforts. Science still claimed and secured his allegiance, but, like his contemporaries, Wollaston and Young, he was not destined to grow old in her service. The constant strain of ten years of almost delirious excitement, in which he seemed to pass from triumph to triumph, began to tell upon his nervous and impressionable nature. He had already experienced more than one serious breakdown. After his great discovery of the alkaline metals he utterly collapsed, and for a time his life hung upon a thread. Accordingly, after his marriage in 1812 he decided to resign his lectureship, and, although in deference to the wishes of the managers he still remained titular professor and director of the chemical laboratory, after 1813 he took no very active part in the management of the institution. But a beneficent Fortune still seemed to wait upon it. In the very year of his resignation he discovered Faraday—the greatest of all his discoveries—and the continued existence of the Royal Institution was thereby assured.

The lecture of 1810 may, then, be regarded as a sort of testament in which its author lays down his views concerning the true end and aim of the institution which he had laboured so strenuously and so successfully to establish. Stated in their simplest terms and in his own words, these were: "to apply its funds to useful purposes; to promote the diffusion of science; to encourage discovery; and to exalt the scientific glory of this country." In reviewing its history during the ten short years of its adolescence, Davy could at least claim that it had not been useless to the British public.

It might, I conceive, be demonstrated (he says) that it has not only assisted the progress of genuine science, but has likewise diffused a general knowledge of the advantages and importance of scientific pursuits, and as far as it has been subservient to amusement, that amusement has been at least of a rational kind, of a moral tendency, and connected with no improper, no undignified objects.

But he is more concerned to dwell upon the promise of its future than upon the performances of its early youth, striking and brilliant though these were, and as his audience knew them to be. The very modesty with which he referred to those achievements must have struck and, indeed, strengthened a sympathetic chord. In a few graphic sentences, with all the charm and elegance of diction which astonished and delighted the intellectual world of London, he rapidly sketched the rise of the sciences and traced their ennobling influence upon civilisation and the progress of the human mind.

The pursuit and cultivation of science and the diffusion of knowledge being then admittedly the primary and fundamental objects of the Royal Institution, he next turned to the details of his plan for attaining them. He dealt with the original scheme of the foundation, pointed out its imperfections, demonstrated the necessity of modifying and enlarging its constitution, and, last but not least in importance, showed how its financial position could be strengthened in view of the extension of its functions that he contemplated.

To the ideals thus developed the institution has been consistently faithful. Its history during the 108 years that have elapsed since the delivery of this historic discourse is, in effect, an epitome of contemporary science, and especially of British science. Its professors and lecturers have always been leaders who have left their impress upon the science and learning of their time; its laboratories have continued to contribute to and augment that renown which the genius of Davy first showered upon it, and its achievements are among the greatest scientific glories of this country.

There is one circumstance associated with this lecture which deserves a passing reference. In 1810, as now, we were at a crisis in our national history, and those who are at all familiar with the conditions of that time will find a hundred analogies in the present happenings. We were then in the throes of a life-and-death struggle with the greatest military genius of his age, the despot who was practically master of Central Europe, and was bent upon the subjugation and humiliation of this kingdom. But there is only the slightest possible allusion in the lecture to the critical conditions of the time—so slight, indeed, that it might well escape the notice of a reader of to-day—merely a half-veiled, contemptuous reference to "all the armies and all the edicts which have lately been so vainly opposed to our prosperity." The calm and resolute courage with which the lecturer and his audience faced the peril of that time may surely inspire and strengthen us with an equal confidence. History is now repeating itself. Let us hope that it will continue to repeat itself, and that, taking heart of grace from the example which has been set us, we may find our faith abundantly justified.

T. E. THORPE.

THE DRIFT OF THE "ENDURANCE."

OWING to the circumstances of the time, the preparation of the preliminary reports by the men of science attached to the Weddell Sea contingent of the Shackleton Expedition has been unavoidably retarded, that of Lieut. Wordie, dealing with the oceanography, being the first to appear.[1] It is a report of great interest, and that so much valuable research was accomplished on a vessel specially equipped to meet the requirements of a land expedition reflects much credit on all concerned.

Sir Ernest Shackleton, meeting with extremely unfavourable ice conditions in Weddell Sea during the summer of 1914–15, was unable to establish the contemplated base on Luitpold Land for his trans-Antarctic sledge journey. After a long struggle with pack, the *Endurance* was beset in the middle of January, 1915, when only fifteen miles from the land, in lat. 76½° S. A strong N.E. wind that had blown for several days with gale force packed the ice tightly, so that, in spite of every effort, no progress could be made. A month later the young ice was 6 in. thick, and by the end of February, which corresponds with the month of August in the northern hemisphere, had increased to the thickness of a foot.

During the drift of the vessel until she was crushed on October 27, the natural history of sea ice was studied and other physical observations made. These included meteorological observations every four hours by Mr. Hussey, absolute magnetic determinations at regular intervals by Mr. R. W. James, while frequent soundings and numerous series of ocean temperatures and densities were made by Lieut. Wordie. Systematic collections of plankton and other biological material from the surface to depths of more than 400 fathoms were made by Mr. Clark, the biologist, but, unfortunately, this rich material so laboriously brought together had to be abandoned when the *Endurance* was crushed. The greatest interest attaches to the soundings, which show that a line of relatively deep water runs south from 74° to 76° S. to the Wilhelm Barrier. Off the Luitpold coast to the east there is shallow water less than 100 fathoms deep, while in a westerly direction the edge of the continental shelf is marked by depths under 250 fathoms.

The drift of the vessel lay over the continental shelf from the end of March until the end of July, so that it was possible to investigate it over a length of 270 miles from S.E. to N.W. As the ship drifted to and fro the breadth of the shelf was shown to vary from forty miles in the S.E. to seventy miles in the N.W. No idea as to the distance of the coast could be obtained, as the water did not shallow gradually in any direction. "The shelf . . . is made up of a group of terrace-like levels the edges of which are steep and nearly parallel to each other along a S.W.–N.E. line." The shallow water ends abruptly a little north of lat. 73½° S., long. 48° W., the ship's position on July 31. A sounding made five days later, when a gale from the S. had driven the *Endurance* into lat. 71° 42′ S., long. 49° 21′ W., gave 1146 fathoms.

This sharply defined margin of the so-called "continental" shelf seems to be characteristic of Antarctic areas, as shown by pairs of soundings a few miles apart on the *Belgica*, *Gauss*, and *Scotia* operating in widely separated regions. Until the *Endurance* sank, six other casts were made in depths between 1500 and 1900 fathoms, so that the land to the *east* in lat. 68° S., reported by Morrell in 1823, must, if it exists, be an island, and not a part of Antarctica proper. Sir James Ross had reported a "strong appearance of land" some 5° due north of the position given by Morrell for his land, so that it is not improbable that in the unexplored area 165 miles broad at the narrowest point lying between the tracks of Shackleton and Filchner there may be a large island or a cluster of small ones, as suggested by Ross. There seems little doubt that Morrell did visit Weddell Sea in 1823, and that the land he saw and coasted along to its north cape was the east coast of Graham Land previously reported by Capt. Johnson and explored by Larsen seventy years after Morrell's visit. In 1823, as shown by Capt. Weddell's voyage a few weeks earlier, the sea south of the circle was free of pack, so that an approach from the east to the normally ice-congested waters off the coast of Graham Land was quite a feasible proposition. Morrell's longitudes were, however, some 10° out, owing to an error in his chronometers, so that his most southerly position on March 14, 1823, would coincide with that of the *Endurance* on August 25, 1915. The land reported on March 17 was evidently the southern point of Föyn coast, as determined by Larsen, while the N. cape of New South Greenland, which Morrell by dead reckoning two days later placed in lat. 62° 41′ S., long. 47° 21′ W., was obviously the north point of Joinville Island, 8° of longitude further to the west than the position assigned by him.

Lieut. Wordie's paper contains much interesting matter, to which full justice cannot be done until the physicist and the meteorologist of the expedition have submitted their reports. A special feature of the Weddell Sea winter climate in high latitudes seems to be the absence of low temperatures. In the winter months of 1912 the absolute minima on the *Deutschland* were but little lower than those at the S. Orkneys, some 500 miles to the north, and in 1915, the coldest winter of the coldest and calmest year on record at this island station, mercury never froze on the *Endurance,* although the vessel was from 550 to 800 miles farther south. Meanwhile, it is not possible to say why this should be so. Above the cold surface cap, Barkow has shown that a relatively warm stratum of air is usually present in winter, which under certain conditions might replace the film of cold air lying over the pack ice. It is not unlikely that the seasonal march of temperature in

[1] Lieut. J. M. Wordie, R.F.A., "The Drift of the *Endurance* *Geographical Journal*, vol. li., No. 4, April, 1918.

the southern parts of Weddell Sea resembles that of the McMurdo Sound area in having a uniform winter temperature, instead of a sharp descent to a minimum. A steady Föhn effect of wide radius from the mountains of the Antarctic continent would explain this anomaly, as would also the incursion of relatively warm air from lower latitudes associated with incurved cyclonic N.E. winds in the eastern part of Weddell Sea. Dynamic heating in the *free air*, without the intervention of high land, is also within the bounds of possibility. R. C. MOSSMAN.

NOTES.

WHILE the British Association has suspended its annual gatherings for the last two years, the Società italiana per il Progresso delle Scienze, the head offices of which are at 26 Via del Collegio Romano in Rome, sends us a very attractive programme of the tenth meeting, which is to be held in Pisa on October 16–19 under the presidency of Prof. Ferdinando Lori and the secretaryship of the indefatigable Prof. Vincenzo Reina. The success of the meetings at Rome in 1916 and at Milan and Turin in 1917 has convinced the council that it will be interpreting the wishes of the members in continuing even in war-time to maintain its activity in promoting the advancement of knowledge in the country. We notice that such subjects as mathematics, physics, chemistry, and aeronautics do not figure in the proceedings of the sections, which are to be devoted mainly to geological and mineralogical papers in Class A, biological and medical in Class B, and economical in Class C. It is the object of the meeting to pay a large amount of attention to the study of the mineral resources of Italy. At the same time the Italian Thalassographic Commission is organising a subsection of Class B on fisheries, and is presenting an annual report, while similar reports are being presented by the Glaciological Committee and the National Commission for the Development of Scientific and Industrial Progress. The Italian Association for the Study of Building Materials is to meet in Pisa at the time of the congress. The opening meeting of the scientific gathering is to be held on Wednesday, October 16, at 10 a.m., in the Aula Magna of the University, when an inaugural address will be given by Prof. Raffaello Nasini on "A Proposal for an Inventory of Italy's Mineral Wealth." In addition to the sectional meetings, nine general lectures have been arranged for the mornings of the subsequent days, while the sections will meet in the afternoons, and an excursion will take place on the Sunday.

THE recent flight from England to Egypt, made by two R.A.F. officers and two mechanics, is an excellent example of the possibilities of aircraft with regard to long cross-country flights, and shows in an unmistakable way that the commercial use of the aeroplane after the war could be very rapidly developed. If a flight of 2000 miles can be satisfactorily made without special preparation on an ordinary service machine, it is fairly obvious that there are practically no limits to the possibilities of commercial aviation when the whole attention of designers can be given to the subject, and when the excellent research facilities which we possess can be devoted to the elucidation of the new problems involved. The war has worked wonders in promoting the development of aeronautical engineering, and such feats as the above leave little doubt that one of the good after-effects of the war will be the immediate application of our greatly increased knowledge of aviation to the problems of international commerce. The question of long oversea flights is fraught with more difficulties than attend long flights overland, but there are many who think that a cross-Atlantic flight is already within the bounds of possibility. The future of the aeroplane is bright with promise, and the declaration of peace will doubtless inaugurate a new era in the annals of commercial transport.

MR. CHARLES HERBERT SCOTT, whose death is announced, was born in 1860 at Lincoln, and was a member of the Institution of Mechanical Engineers. He was an authority upon linoleum manufacturing machinery, and was the patentee of many of the machines used for this process.

WE regret to note that *Engineering* for August 16 announces the death of Mr. Daniel Makinson Fox in his eighty-ninth year. After a varied railway experience at home and abroad, Mr. Fox acted as principal engineer of the Sao Paulo Railway in Brazil. He was a member of the Institution of Civil Engineers, and read a paper in 1870 on the Sao Paulo Railway.

THE death of Mr. Bramah Joseph Diplock, announced in the *Engineer* for August 16, will be regretted by many who took an interest in his well-known invention, the pedrail. Although he had no early technical training, Mr. Diplock's insight into things mechanical was remarkable, and he held some 100 patents in connection with transport machinery.

THE Mary Kingsley medal of the Liverpool School of Tropical Medicine for research in tropical diseases has been awarded to Dr. Griffith Evans, the discoverer of the trypanosome of Surra, a disease of horses and camels of India, Burma, and the East. Dr. Evans, who was born in 1835, has been a member of the Veterinary Department of the Army, and made his discovery in 1880. He contributes on the occasion of the award of the medal an interesting autobiographical note to the *Annals of Tropical Medicine and Parasitology* for July (vol. xii., No. 1).

SOME additional information regarding the Hog Island shipyard has been obtained by Lloyd's Register of Shipping, and appears in an article in the *Engineer* for August 16. The methods adopted for training the men are of interest. No skilled labour could be obtained, and a school was started, which provides daily from 300 to 400 men for the yard. A section of a ship has been built, where men are taught riveting, caulking, erecting, bolting up, pipe fitting, and any trade necessary. It is marvellous to see how quickly and how well they learn. The first ship was launched on August 14, and when it is considered that not fewer than two-thirds of the men who have built her never saw a shipyard until about six months ago, it must be admitted to be a wonderful performance.

THE U.S. National Research Council, acting as the Department of Science and Research of the Council of National Defence, has appointed a committee to investigate the fatigue phenomena of metals. Prof. H. F. Moore, of the engineering experiment station of the University of Illinois, is chairman. The committee is charged with the responsibility of developing a knowledge of the strength and durability of metals subjected to repeated stresses, such as ship structures, crank-shafts of aircraft engines, and heavy ordnance. It is expected that much of the experimentation required will be done in the laboratories of the University of Illinois at Urbana under the personal direction of Prof. Moore.

THE autumn meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Westminster, on Thursday and Friday, September 12 and 13. Among the papers that are expected to be submitted are:—The Rate of Change at 100° C. and at Ordinary Temperatures in the Electrical Resistance of Hardened Steel, E. D. Campbell; Some Experiments on the Reaction between Pure Carbon Monoxide and Pure Electrolytic Iron below the A_1 Inversion, H. C. H. Carpenter and C. Coldron Smith; Influences of Hot Working on the Qualities of Steel, G. Charpy; The Casting of Steel in Ingot and other Moulds, J. E. Fletcher; Magnetic Analysis as a Means of Studying the Structure of Iron Alloys, K. Honda; Standardisation of Tests for Refractory Materials, Cosmo Johns; The Utilisation of Waste Heat from Openhearth Furnaces for the Generation of Steam, T. B. Mackenzie; and Influence of Elements on Tenacity of Basic Steel, A. McWilliam.

ACCORDING to the June issue of *Terrestrial Magnetism and Atmospheric Electricity*, the magnetic survey ship *Carnegie* arrived safely at her home port in June last after having been detained for nine months last year at Buenos Aires owing to the methods of sea warfare adopted by our enemies. Her survey work is to be suspended until it can be resumed with safety. The results of the survey of the eastern portion of the Pacific between the middle of Chile and the Bay of Panama, which she was able to make during her journey home in the early months of the present year, are given in the same issue. The United States and British charts are in close agreement with the new measurements so far as the deviation of the compass is concerned, but both charts are seriously wrong in their values of the dip. Errors of three or four degrees are frequent, and errors of five degrees are occasionally present.

IN a letter to the *Daily Telegraph* of August 13, Mr. F. W. Twort, professor-superintendent of the Brown Institution, criticises the procedure of the War Office with reference to the epidemic of dysentery in the Salonika area during 1915 and 1916. Towards the end of 1915 Mr. Twort was appointed in charge of a laboratory at Salonika, and came to the conclusion that much bacillary dysentery occurred in the district. The War Office set up a Medical Advisory Committee for the Eastern area of operations, and this Committee in Egypt issued a report on Salonika. It apparently considered the dysentery of Salonika to be the amœbic form. In consequence of these findings, which he considered to be erroneous, Mr. Twort retired from the Army Medical Service. At the end of 1917 Lt.-Col. Buchanan, a member of the War Office Advisory Committee, admitted that the diagnosis of dysentery by this Committee was wrong; that bacillary dysentery occurred at Salonika; and that certain large cells in the mucus had been mistaken for amœbæ. In spite of these findings, the War Office, Mr. Twort asserts, has so far taken no action to put matters right so far as this is now possible.

THE REV. W. LOWER CARTER, who died on June 19, was from early youth an indefatigable worker in the interests of geology, but it was relatively late in life that he took up scientific work as a profession. He began business life as a bank clerk, and doubtless the experience he gained in that capacity developed the organising abilities for which Mr. Carter was justly known. After a successful university career at Birmingham, Cambridge, and Halle, he entered the Congregational ministry. What time he could spare from his pastoral work was devoted to stimulate and assist scientific research, particularly in connection with the Leeds Geological Association and the Yorkshire Geological and Polytechnic Society. For many years he edited the Transactions of these societies, and, as honorary secretary, organised their various activities. When, in 1908, Mr. Carter resigned his charge in Birkenhead to become lecturer in geology at East London College, and afterwards lecturer in geography at Queen's College, London, he still retained his interest in the Yorkshire societies, and it is largely due to his work that the Yorkshire Geological Society became so prominent among provincial societies. Further scope was afforded his powers of organisation when he acted for several years as recorder of Section C (Geology) of the British Association. The time and energy given to assist the spread of scientific knowledge through these bodies limited his original research work. This, chiefly in the form of short notes, was published in the Transactions of the Yorkshire societies, as also more important contributions on the development of certain river systems in Yorkshire. It is, however, as an organiser and teacher rather than as an investigator that Mr. Carter's name will be remembered among geologists.

THE pleomorphism and developmental cycles of the bacteria is the subject of a paper by Dr. Sopp in *Naturen* (Bergen) for May (No. 5, 1918). In particular he reviews the work of Almquist on pleomorphism and that of Löhnis on the developmental cycle of Azotobacter, in which he claims that conjugation occurs with the formation of various spore-like bodies.

THE July issue of the *Archives of Radiology and Electrotherapy* (vol. xxiii., No. 2) is devoted to the consideration of the treatment of paralysis due to nerve injury, a subject of great importance at the present time. The principal paper is contributed by Lieut. Noel Burke, R.A.M.C. He concludes that rational treatment of this form of paralysis must be directed to the nerve as well as to the muscle. It takes the form of the galvanic current with or without ionisation. Pain can usually be relieved by electrical means or by heat. The muscles should be treated both with massage and with the galvanic or sinusoidal current. A discussion of the paper followed, in which many speakers took part.

THE *National Geographic Magazine* for May is devoted to a survey of the smaller North American mammals by Mr. Edward Nelson. This is a really wonderful achievement, for the author has contrived to crowd a vast amount of information concerning the chief characteristics, and habits, of a very remarkable series of animals into a surprisingly small space. Yet he seems to have omitted nothing material in his task of condensation. A comment of his on the brown rat in South Georgia is worth bearing in mind. This animal, he tells us, was introduced into the island from whaling ships, and now, owing to the abundant supply of food furnished by the great number of whale-carcasses which drift ashore each season, it may be found there in millions. Sooner or later this source of food will cease, and it will then go hard with the great colonies of penguins which still nest there unless means for the destruction of this pest are speedily devised. In addition to a large number of coloured plates of great beauty are numerous text-figures, illustrating the tracks made by various animals when walking and running.

THE *Journal of Agricultural Research* (Washington) for June (vol. xiii., No 10) contains an account by Mr. R. W. Glaser of a new bacterial disease of gipsy-moth caterpillars. It was apparently introduced with some eggs of the Japanese gipsy moth, and the infection later spread to the American race. The disease manifests itself in the caterpillars, which suffer from diarrhœa, cease to eat, lose muscular co-ordination, and die. The microbe is a streptococcus and is conveyed by ingestion, and the muscular tissue of the insect is first attacked. The disease was introduced into woods heavily infested with the gipsy moth, and in two localities severe epidemics were produced. It is hoped that it may be of service in helping to combat the ravages of the gipsy moth. In another paper in the same journal Mr. J. Rosenbaum discusses the survival of the blackleg organism of the potato in the soil during winter. The organism (*Bacillus phytophthorus*) does not seem to be able to survive in the soil or in diseased tubers that may remain there under winter conditions.

THE Kew Bulletin, we are glad to notice, is being published this year with regularity, and five numbers have already appeared. In No. 5 there is a valuable article on the preservation of wood by the application of chemicals, which plays so important a part in timber economy. The chief value of preservatives is to render the wood less susceptible to the attacks of parasitic fungi, to make it waterproof and less inflammable, and to prevent the attacks of boring insects. A general account of the subject is given, and then attention is directed in detail to the important book on the subject recently published by Mr. A. J. Wallis-Tayler. The various chapters of the book are reviewed, and this is followed by a bibliography of works upon other definite branches of wood preservation, such as wood pavement, creosoting railway sleepers, etc. A number of the works cited have been published in the United States and some from India, while others dealing with the treatment of timber for estate purposes have been published in the *Quarterly Journal of Forestry*.

THE Journal of the Royal Agricultural Society (vol. lxxviii.) contains two papers relating to milk production and distribution which are of interest to a far wider circle of readers than the members of the society. Mr. James Mackintosh, adviser in dairying to University College, Reading, discusses the effect of the new agricultural policy on the dairy-farming industry. The increase in arable area at the expense of the grass area is thought by many dairy-farmers to necessitate a reduction of herds, but although Mr. Mackintosh declines to accept this conclusion, and offers evidence that more food for cows can be produced when a certain amount of grassland is broken up, he anticipates that the higher cost of production and the greater labour involved in arable dairying as contrasted with other systems of farming, which may in the future be equally remunerative, may lead to a decline in milk-production in districts best adapted for corn-growing, such as the Eastern Counties, and hence possibly to difficulties of supply in these areas. In the West a decline is less to be feared if the prices of milk and milk products allow of reasonable profit, and adequate means of education are provided. In a paper on the wastage of milk Dr. R. Stenhouse Williams gives some striking figures as to the extent to which milk is at present lost by souring, splashing, and in other ways, and indicates the lines along which a rational system of production and distribution of clean milk might be organised.

THE unknown Belcher Islands, in the south-east of Hudson Bay, were explored in 1914 and 1915 by Mr. R. J. Flaherty, who for the last six years has been examining the Hudson Bay region, the Ungava Peninsula, and Baffin Land for iron-ore and other mineral deposits. Mr. Flaherty has an article on the islands in the June number of the *Geographical Review* (vol. v., No. 6). The article contains several illustrations and the first map of the islands to be published. Previously they were represented on charts by dotted outlines of incorrect shape and position. It appears that the Belcher Islands consist of several long, narrow islands extending north and south for ninety-one miles, with an extreme width of fifty-seven miles. Their area is more than 5000 square miles. The islands are low, rising barely to 500 ft. at most, and studded with lakes well supplied with salmon and other fish. Harbours are numerous. Vegetation is scanty, and there are no trees, but animal life is abundant. A tribe of Eskimos, consisting of only five families, permanently inhabit the islands. Other Eskimo from time to time migrate from the mainland in search of walrus, sea-fowl, and, before their disappearance, caribou. Mr. Flaherty reports large deposits of iron-ore, not, however, of high quality. It is remarkable that such a large and not unimportant group of islands, comparatively near to civilisation and easy of access, should have remained so long unexplored.

KISSKALT'S view that the action of the sand filter in water purification is biological and due to the destruction of bacteria by other organisms is contested as the result of experience at the Zürich waterworks, where the lake-water is filtered in two stages through sand. According to L. Minder (*Journal für Gasbeleuchtung und Wasserversorgung*, No. 61, 1918), the first layer retains most of the fresh-water planktons, but allows some of the bacteria to pass. The bacteria are retained by the second filter and at the surface, so that at a depth of 10 cm. the number per cubic centimetre has already fallen to one-tenth. Furthermore, the retention of bacteria is satisfactory even when there are considerable fluctuations in the number of bacteria in the water. Thus it is concluded that the process is mechanical rather than biological.

ACCORDING to the *Annali d'Ingegneria e d'Architettura* for June 16, a strong committee of business men has been formed to consider the possibility of constructing, after the war, a canal connecting Milan with Lake Como, and joining the important waterway which it is proposed to make from Milan to Venice, thus opening up the rich plains of Lombardy to cheap means of transit. The works involved would comprise a canal from Milan to Vimercate, a vast tunnel from Vimercate to the River Adda, and the canalisation of the Adda from Paderno to Lecco. The scheme has the approval of the city of Milan, and will be supported by the Edison Company, which is the chief user of the waters of the Adda. Some of the features of the new undertaking are discussed, and the advantages which the new canal would confer on Milan are explained. The distance by water from Milan to Lake Como would be reduced by about eleven miles.

IN a paper on the limit of sensibility of the eye and the minimum of power visually perceptible, which appears in the March–April issue of the *Journal de Physique*, M. Buisson claims that the eye is much more sensitive than it has been thought to be. A number of discs of diameters from 2·5 to 5 millimetres were covered with phosphorescent material, and the light sent out by them determined by the Fabry-Buisson micro-photometer to be between two and four candles per square centimetre. Two of these discs of the same size and strength were mounted on a screen, which was gradually removed from the observer and at the same time rotated about his line of sight, and he was required to state the direction the line joining the two discs made with the horizontal until with increase of distance it became impossible. For discs of different diameters and strengths the limit of perception was found in all cases such that if there were no absorption of light by the atmosphere a candle would be visible at a distance of 27 kilometres. This is equivalent to a star of the eighth magnitude, and it is probably the light of the sky which prevents stars of higher magnitude than the sixth being visible.

Engineering for August 9 has an illustrated article descriptive of an electrically welded barge, which has been built at a yard on the south-east coast under Government control. This barge is 120 ft. long and 16 ft. beam, and has a displacement of 275 tons. The vessel, with full cargo, has been at sea during exceptionally rough weather, and answered satisfactorily in every way to the test imposed. No rivets were used in the construction, the whole of the structure being put together by electric welding. The adoption of this system was a direct consequence of experience in welding by means of the flux-coated metal electrode process at the Admiralty dockyards. There are seventy-one transverse frames in the barge, with three bulkheads; plates of thicknesses $\frac{1}{4}$ in. and $\frac{5}{16}$ in. were used for the shell plating. It is estimated that future vessels of this size should be built with a saving of 25 to 40 per cent. of time and about 10 per cent. of material as compared with ordinary riveted barges. The United States Shipping Board is making arrangements for the building of a number of 10,000-ton standard ships in which the use of rivets will be reduced to about 2·5 per cent. of the normal number.

THE problem of ascertaining the distribution and magnitudes of the stresses in a revolving disc by means of mathematical formulæ is tedious and complicated. With the exception of the cases of discs of constant thickness and constant strength, for which definite integrals can be found, the analytical solution involves highly complex equations, and the ultimate result is doubtful. In the course of an article in *Engineering* for August 9, Mr. H. Haerle describes a method which can be applied to any sectional profile and reduces the mathematical work to a minimum, while at the same time results are obtained which are sufficiently accurate for all practical purposes. The general formulæ are given by Dr. Stodola in his book on steam turbines, and from these other expressions are deduced for the sum and difference of the principal stresses. Mr. Haerle has prepared a chart showing the relation of these sums and differences with tangential velocities, and shows how the chart may be applied to the solution of discs of uniform thickness with and without a central hole, discs of hyperbolic profile, and turbine discs having the tapered sides usually employed in practice. An example of an impeller disc for a turbo-compressor is also worked out. Mr. Haerle's method gives remarkable agreement with the mathematical method, and certainly simplifies greatly an exceedingly complicated problem.

MRS. M. T. ELLIS contributes to the June issue of the *Biochemical Journal* three interesting papers on the plant sterols. In the first is recorded the failure to isolate a typical phytosterol from the vegetative organs of the cabbage plant or from the fæces of rabbits fed on a cabbage diet, although from the latter source a small quantity of a substance giving the cholesterol colour reactions was separated. On the other hand, cabbage-seeds contain a relatively large amount of crystalline matter apparently similar to the mixture of phytosterols present in rape-oil, which is interesting in view of the fact that both rape and cabbage belong to the genus Brassica. Grass-fruits also contain phytosterol, but a larger amount of chortosterol. The second paper deals with the sterol content of wheat, and it was found that the chief phytosterol present both in the grain and in the embryo is sitosterol. The bran contains a phytosterol, but one different from sitosterol. A method of estimating phytosterol was devised based on the insolubility of the compound of this substance with digitonin. The quantity of phytosterol in the etiolated wheat-plant is approximately the same as in the grain, but it is higher in the adult plant. In the embryo the percentage of phytosterol is much higher than in the plant, thus suggesting an essential function in germination and growth. In the third paper ("The Occurrence of Phytosterol in some of the Lower Plants") it is shown that a mixture of ergosterol and fongisterol, previously known to occur in fungi, is present in *Polyporus nigricans*, and probably also in *P. betulinus*. From the alga Laminaria, the Musci Sphagnum, and the fungi *Agaricus rubescens* and *Lactarius subdulcis* oils were obtained which gave the cholesterol colour reactions.

MESSRS. BUTTERWORTH AND CO. (INDIA), LTD. (Calcutta), have sent us a copy of their Medical Catalogue for 1918. It is a very comprehensive list of works published in Great Britain, India, and America on medicine, surgery, dentistry, obstetrics, pharmacy, ophthalmology, and the allied sciences. As it is carefully arranged according to subjects, and the prices are given in Indian currency, it should be very useful to medical men resident in India and the Far East, to whom it will be sent free by the publishers upon application.

MESSRS. T. C. AND E. C. JACK, LTD., announce two forthcoming books by F. Martin Duncan, viz. "Wonders of the Seashore" and "How Animals Work." They also promise "Water in Nature," by W. Coles Finch and Ellison Hawks.

THE Oxford University Press is about to begin the publication of "Neurological Studies," from the Seale Hayne Military Hospital, Newton Abbot. It will be edited by Major A. F. Hurst, with assistance.

OUR ASTRONOMICAL COLUMN.

WOLF'S PERIODIC COMET.—Mr. M. Kamensky has further revised his orbit of this comet, applying perturbations by the earth, Mars, Jupiter, and Saturn. His elements are given in *Ast. Journ.*, No. 738:—

$$T = 1918 \text{ Dec. } 13{\cdot}3909 \text{ G.M.T.}$$
$$\left.\begin{array}{l}\omega = 172^\circ\ 54'\ 41{\cdot}83''\\ \Omega = 206^\circ\ 41'\ 31{\cdot}71''\\ i = 25^\circ\ 17'\ 31{\cdot}54''\end{array}\right\}1918{\cdot}0$$
$$\phi = 33^\circ\ 58'\ 31{\cdot}85''$$
$$\mu = 522{\cdot}42893''$$

The Greenwich observations in July indicate the very small correction +0·0046d. to the value of T.

Ephemeris for Greenwich Midnight

	R.A. h. m. s.	N. Decl. ° ′
Sept. 3	20 0 38	22 20
7	20 0 17	21 13
11	20 0 36	20 0
15	20 1 36	18 43
19	20 3 17	17 23
23	20 5 39	16 1
27	20 8 44	14 37
Oct. 1	20 12 31	13 12

Values of log r, log Δ: September 3, 0·2726, 0·0274; October 1, 0·2415, 0·0242 respectively.

The comet is nearest to the earth on September 20, and the theoretical brightness is greatest on October 12.

FAINT STARS WITH LARGE PROPER MOTIONS.—Mr. Furuhjelm's investigation of the proper motions of the stars in the Helsingfors astrographic zone (39° to 46° N. decl.), between R.A. 9h. and 12h., has already been noticed in NATURE. He has now published a smaller list (*Öfversigt af Finska Vetenskaps-Societetens Förhandlingar,* Bd. lix., Afd. A., No. 22), which extends from R.A. oh. to 24h., but includes only stars the annual proper motion of which is 0·5″ or more. They are sixty-three in number, but the proper motions of more than half of these had already been published. However, more than twenty are new, being faint stars of the 10th or 11th photographic magnitude. They have been derived by the aid of the blink microscope from pairs of plates taken at intervals of several years. The author believes that the list contains all the stars in the zone down to the 11th magnitude, whose P.M. amounts to 0·5″. In a separate publication he gives a detailed study of the faint star which he found in 1914 to have the same P.M. as Capella. His final result for its P.M. is +0·0071s. in R.A., −0·434″ in decl., Boss's values for Capella being +0·0082s., −0·429″. The place of the small star (the photographic magnitude of which is 10·6) for 1900·0 was 5h. 10m. 1·20s., +45° 44′ 21·5″, that of Capella being 5h. 9m. 18·04s., +45° 53′ 47·0″. The distance between them is 12′ 4″. Making allowance for the greater distance of Capella from the sun, the system shows a close analogy to that of α Centauri and its distant companion, which Mr. Innes has named Proxima.

PERIODICITY OF SOLAR RADIATION.—In continuation of the preliminary work of Clayton (NATURE, vol. c., p. 14), Dr. C. G. Abbot has made a further investigation of possible periodicities in the short-interval variations of the "solar constant" (Smithsonian Miscell. Collections, vol. lxix., No. 6). The method adopted was to calculate the coefficients of correlation between the solar constants of given days and those of one to forty days later, as observed from 1908 to 1916. There appears to be no well-marked periodicity which persists through the whole period of observation, but some of the results for individual years are of interest. Thus, in 1915, a period of about twenty-seven days, doubtless associated with the solar rotation, was strongly shown, the observations suggesting that one side of the sun was hotter than the other during several rotations. This result is of considerable importance as furnishing additional evidence that the short-period variations are of truly solar origin. The year 1916 was unique in giving indications of a period of about 3½ days.

THE SPECTRUM OF MIRA.—The bright lines recorded in the spectrum of Mira by Stebbins in 1903 have been further investigated by W. S. Adams and A. H. Joy (Pub. Ast. Soc. Pac., vol. xxx., p. 193). Some additional lines are shown in a photograph taken on March 2, but the principal interest attaches to the suggested identifications of the lines. Apart from the well-known lines of hydrogen, the bright lines appear to be mainly due to iron and magnesium, and in each case the lines involved are those which have their greatest intensity at low temperatures. The brightest line, next to the lines of hydrogen, is the magnesium line λ 4571, which is the most characteristic line of the flame spectrum. Similarly, the iron lines which occur are those of the low-temperature groups *a* and *b* of the classification of Gale and Adams. The lines in question make their appearance, or at least become more intense, as the star approaches its minimum of light, and it would seem that the radiating gases undergo a reduction of temperature as the star becomes fainter.

THE NEW STAR IN AQUILA.

THE following estimates of brightness of Nova Aquilæ made by M. Paul Blanc at Fourcalquier are included in Circular No. 27 of the Marseilles Observatory :—

Date	h.	m.	Mag.	Date	h.	m.	Mag.
June 8	21	10	1·0	June 21	22	20	2·8
9	21	55	0	22	21		2·8
9	22	40	0·2	23	21	40	2·9
10	22	15	>1·0	24	21		3·0
13	22	15	1·0	25	21	15	3·3
14	21	45	1·2	27	22		3·9
15	22	15	1·5	28	22	50	3·9
18	21		2·3	29	21	20	3·6
19	21	30	2·3	30	22	50	3·6?
20	22		2·5				

Details are also given of determinations of the brightness of the nova in the wave-lengths 645, 558, and 412 made at Florence by M. Maggini. The observations indicate that the nova did not radiate as a black body.

The following collection of references to the history of the nova prior to the outburst in June has been communicated by Dr. C. Easton, of Amsterdam :—1892, August 14, Algiers Astrogr. Chart No. 341 (Zwiers), mag. 8·8; 1894, September 21, Barnard's Photographs of the Milky Way, Publ. of Lick Obs., vol. xi., plate 59 (Easton), mag. 10·5; 1895, June 26, Algiers No. 141 (Jonckheere), mag. 8·8; *id.*, 1909, August 20, mag. <8·8 (*vide* NATURE, No. 2537); 1909, June 20, M. Wolf, *Ast. Nach.*, No. 4949, mag. 10·5; 1910, Franklin Adams Chart, mag. <8·8; 1912, July, Bailey's N. Milky Way, Harvard Annals, vol. lxxx., No. 4 (Nijland). In Barnard's photograph of 1894 the nova is 20 mm. from the left, and 5·5 mm. from the bottom of the plate. Dr. Easton remarks that there seems to be sufficient evidence of the variability of the nova.

Messrs. I. Yamamoto and Y. Ueta, of the Kyoto University, inform us that they independently discovered the new star on June 11, during an expedition to observe the recent total eclipse of the sun. Owing to the rainy season very few observations were secured, but it was observed that the star became fainter and redder until June 29, when there was a slight recovery.

The star is still easily visible to the naked eye, being now between the 4th and 5th magnitudes. On August 10 Prof. Fowler noted that the green nebular line was the most conspicuous feature of the visible spectrum.

Father Cortie sends the following records of observations on August 13 and 15. On the former date the star, according to Mr. Butterworth, was of magnitude 4·3 visually and 4·7 photographically. The maximum of brilliancy has shifted from the red to the green, and the image in the telescope has lost its ruddy hue, and is of a blue tint. In a McClean spectroscope H_α was very much reduced in brightness; a yellow line, presumably D, was seen, and vivid bright lines at 5007, H_β, 4640, and about H_γ. The following wave-lengths of the principal bright bands were determined from a photograph: 3867, H_ζ, H_ϵ, H_δ, H_γ, 4363, 4640, 4680, 4713, H_β, 4958, and 5007. The bands about H_γ and 4640 were the brightest. On August 15 H_γ and 4363 were the brightest. The mean width of the hydrogen bands is about 50 Ångström units. While the bands at H_γ and 4640 are triple in character, H_δ is composed of a double band. The spectrum on the dates named was almost exactly like that of Nova Persei in August and September, 1901, when its magnitude was between 6 and 7.

THE DEVELOPMENT OF SCIENTIFIC INDUSTRIES.

ONE interesting feature of the British Scientific Products Exhibition, arranged by the British Science Guild at King's College, London, is the series of short lectures and demonstrations given with the special aim of directing public attention to the necessity of developing the scientific industries of the country. These lectures cover a wide range, and by reminding us how ill-prepared we were at the outbreak of war to cope with the vast industrial tasks involved in the supply of munitions of war, they should help to stimulate effort with the view of preventing the occurrence of a similar disadvantage in commerce when hostilities cease.

Lord Sydenham, who opened the exhibition on August 14, pointed out in his address that the Germans with deliberate design had penetrated our whole commercial system, and had obtained control of some of our key industries. We were at first not in a position to start the new industries which were vital to success, and which the Germans had laboriously built up. At present, as Lord Sydenham pointed out, there is not a single branch of the industries of war in which we cannot excel the Germans, and from this fine achievement we can draw lessons of supreme importance for the future. Lord Sydenham also emphasised a lesson which the war had taught us, that small quantities of material had enormous influence in determining production, and large industries were vitally affected by small industries. The dye industry, which Germany had largely developed with an eye to war as well as to industrial supremacy, was quoted as an example of this. We paid Germany nearly 2,000,000*l.* per annum for dyes, upon which depended an industry of more than 200,000,000*l.* per annum. The great chemical works of Germany had almost monopolised this and other key industries, and when war broke out the works engaged thereon were ready to be turned on to the production of explosives and propellants. Lord Sydenham expressed the opinion that the new Education Act, if properly used, would provide the machinery to add largely to the number of our science-workers. When the Bill was before the House of Lords he endeavoured to introduce the word "science" into it, but the official objection was that it would be inappropriate to specify a particular item in such a Bill. In conclusion, Lord Sydenham pointed out that two factors were operating to bring about certain victory in the field. The first was the splendid gallantry and devotion of our fighting men; the second, the resourcefulness and hard work of our men and women, which had enabled them to be supplied with the best weapons science could produce. If, when victory was ours, we diligently applied that resourcefulness to the arts of peace, we should be able to recreate national prosperity on a broader and more enduring basis than it had possessed in the past.

A German chemist, Dr. Otto N. Witt, soon after the declaration of war, expressed the opinion that the manufacture of dyes could never be established in this country because we lacked the knowledge and experience as well as, according to his view, the moral qualities requisite for so great an undertaking. Sir William Tilden, in the first of two lectures on "Lessons of the Exhibition," pointed to the products exhibited, which, he said, demonstrated that these estimates of the British men of science were altogether mistaken, and he claimed that we had every reason to be proud of the result. Sir William Tilden explained and illustrated the use of the word "research," which is now so freely used, but the true meaning of which is rarely understood. Some of the modern applications of scientific knowledge in chemical manufactures afford excellent examples, such, for instance, as the successful establishment of the contact process for making sulphuric acid, the production of ammonia from gaseous hydrogen and atmospheric nitrogen, and the oxidation of ammonia into nitric acid. In the second of his lectures Sir William Tilden mentioned that research in science is undertaken by two distinct classes of people. There is, first, the divinely gifted genius who pursues investigation for the purpose of finding out the laws of Nature and answering the eternal question, Why? Such a man was Faraday, and such a man is the president of the Royal Society, Sir Joseph Thomson. These lead the way, and provide stepping-stones for the second type of man, who wants to get practical results from his labour; and so we have what is called pure science and applied science. In both directions the first requirement is exact observation. This generally means measurement of weights, volumes, temperatures, times. In the first lecture Sir William Tilden illustrated this by referring to progress in chemistry; in the second, he referred to the modern developments in the use of steel. This is an age of steel. But the steels in use at the present time present extraordinary characteristics in strength, hardness, and cutting properties. These are produced by adding small quantities of manganese, nickel, chromium, tungsten, or other metals, of which practically nothing was known in the pure state until the use of the electric furnace by Moissan twenty-five years ago. Moissan was the pioneer in pure science whose discoveries rendered possible the practical achievements of Sir Robert Hadfield and other great steel-makers.

Metals generally are distinguished by their remarkable surface actions. The property possessed by platinum of causing the combination of oxygen gas with hydrogen and other combustible substances was discovered by Sir Humphry Davy just one hundred years ago. But many other metals present still more remarkable powers. One of the most valuable is the power possessed by nickel of causing hydrogen to combine with heated oil, converting it into a fat which is solid when cold. A substance which acts in this way is called a catalyst, and catalytic actions are now being turned to account on a large scale in a great variety of ways in making sulphuric acid, nitric acid, and ammonia, in the surface combustion of gas, in obtaining solid fats from whale-oil, and in a variety of manufacturing processes. Here again the pioneering study of the facts precedes their application. A great field is open in the study of catalytic effects.

In both his addresses Sir William Tilden referred to the question of training chemists. We are still very short of chemists, physicists, and skilled technologists, and he emphasised the fact that, unless steps are taken to train a large number of boys and girls, we shall be as badly off as ever after the war. In passing, he mentioned the valuable work done by many women chemists, and expressed the view that this was a calling to which many educated girls might advantageously devote themselves. The supply of men, he said, will depend chiefly upon the use of scientific method and the more extensive teaching of facts and principles in the secondary and greater public schools, where the education of the governing class is chiefly carried on, and where reform is most urgently needed.

Mr. R. R. Bennett, of the British Drug Houses, Ltd., in the course of a lecture on "Progress in Pharmaceutical Products," said that the total number of vegetable drugs which have become unobtainable owing to the closing of enemy countries is remarkably small, but the cultivation of drug-yielding plants should be prosecuted in this country to the utmost, and the resources of our Colonies should be developed to an increasing extent for the supply of vegetable drugs which cannot be grown in this country. In dealing with fine chemicals Mr. Bennett said that quinine, morphine, and strychnine, three of the most important of the vegetable alkaloids, and ether and chloroform, the two most important anæsthetics, have all along been British products, while the production of many other alkaloids, such as atropine, hyoscine, eserine, and emetine, and very many synthetic organic chemicals, has been stimulated during the war. In 1914 the manufacture of salicylates was practically a German monopoly, but in 1918 it is an established British industry. So far, during the war, whenever a particular substance has been required for a particular purpose, whether it be for medicinal, technical, or war purposes, British chemical science, *plus* British chemical industry, have not failed to produce it in requisite amount and of requisite purity within a reasonable time. Mr. Bennett next reminded his audience that for analytical and research purposes chemical reagents are required to be of a very high degree of purity. Previous to the war such chemicals were to a large extent, though not exclusively, imported from a few well-known German manufacturers, but several British firms have successfully undertaken the manufacture of these chemicals, so that the supply of analytical reagents has not failed. The lecturer next showed a series of dyes used as microscopic reagents. These dyes were from two to four times the strength of the microscopic reagents by German manufacturers. Mr. Bennett said that if the fine chemical industry is to be developed in this country on a scale anything like commensurate with its importance—and it must be borne in mind that it is a key industry, and therefore of paramount importance to the general development of national industry—Government assistance at the conclusion of hostilities will for a time be absolutely essential.

Mr. Edmund White, managing director of Hopkin and Williams, Ltd., lectured on the monazite and thorium industries as key products, pointing out their importance in relation to the gas-mantle industry.

Before the war the German ring had secured almost complete control of monazite, not only in Brazil, but also in Travancore—a protected native State in our Indian Empire. During the year preceding the outbreak of war this trust was endeavouring to bring about a virtual monopoly of the gas-mantle business, and had called in Berlin a meeting of the chief manufacturers of the world. Thorium nitrate is the one essential constituent of gas mantles, without which they cannot be made, and the trust notified these manufacturers to join the combination under threats to withhold supplies of thorium nitrate if they refused to do so. This would mean closing down the business of any manufacturer who would not come into the arrangement. A further proposal was to add 1*d*. on the price of each mantle sold, of which two-thirds of a penny should be taken by the German trust, and one-third of a penny retained by the manufacturer. The world's consumption of gas mantles is estimated at 400,000,000 per annum, and the two-thirds of a penny to be abstracted from the public on each mantle meant an additional profit of about 1,000,000*l*. sterling per annum for the German ring. In September, 1914, Mr. White, thinking the time propitious, proceeded to India and succeeded in obtaining concessions to work monazite sand in private lands outside the territorial limits controlled by the Travancore Minerals Co., which was under contract to dispose of the whole of its sand to the Berlin Auer Co. The Travancore Minerals Co. had been financed from Berlin, although it was nominally an English company registered in London. Messrs. Hopkin and Williams, Ltd., have now established their works in Travancore, and have also founded a thorium nitrate factory in England, which is actually working to-day and producing thorium nitrate of unquestionable quality at an increasing rate. Mr. White exhibited a series of lantern-slides showing the different stages in obtaining monazite in Travancore, and finally stated that this country was now absolutely independent of Germany in these important branches of industry. He also stated that his firm was quite able to hold its own with the Germans in the markets of the world, even though our post-war arrangements gave them no assistance. If the Government so desired, arrangements could easily be made by which Germany should receive for its gas-mantle industry a quantity of raw material in the form of monazite sand or thorium nitrate under the control of ourselves and our present Allies, thus reversing the conditions which existed before the war.

Prof. A. Keith lectured on Monday, August 19, on the value of science to medicine. He remarked that it was not the medical men in hospitals who discovered the scientific principles on which their instruments were based, but the physicists and other workers in laboratories. Beginning with a case just brought from the field of battle into the operating-theatre of a London hospital, he pointed out that the iodine with which the inflamed limb was painted was discovered by a chemist; that Davy, who was one of the first to study the element closely, was the discoverer of the nitrous oxide used as the anæsthetic for the operation; that it was by microscopic observations of a frog's tongue that the method of formation of new nerve-fibres when an injured part has been cut away was found; and that the valuable X-ray bulb was the outcome of purely scientific investigations by Sir William Crookes and others. Finally, Prof. Keith pleaded for more generous provision of laboratories for scientific research carried on solely with the intention of increasing natural knowledge. It used to be said that wars were won on the playing-fields of Eton, but in future they would be won in the laboratories of the country.

Dr. F. Mollwo Perkin, lecturing on the same day on oil from mineral sources, took a broad view of his subject, and referred to oils produced by the distillation of bituminous materials as well as to oils produced directly from the earth. He described the various methods employed for obtaining oil from bituminous materials, and dwelt at length on the means of obtaining these from gas-works retorts. Experiments had been made by the Admiralty with the object of carbonising cannel-coal in vertical gas retorts and producing the fuel-oil. Under the conditions of carrying out these operations it had been found that low-temperature products could be obtained and a good yield of gas produced, together with a rapid throughput, if a large amount of steam were passed through the incandescent coke at the bottom of the retort and then through the descending coal mass. Another source from which low-temperature oils are obtained is producer-gas plant tar. The chief difficulty met with, according to Dr. Perkin, is to design a retort which will carbonise at a low temperature, and at the same time give a rapid throughput of coal—that is, a unit which will pass a large tonnage of coal through in twenty-four hours and at the same time give a maximum yield of oil.

TREATMENT OF CROPS BY ELECTRIC DISCHARGES.

PROF. HENDRICK has described in the *Scottish Journal of Agriculture* (vol. i., 1918, pp. 41–51) the results of some extensive experiments on the treatment of growing crops with an overhead electric discharge. The work was carried out during the years 1913, 1914, 1916, and 1917 on Mr. Low's farm of Mains of Luther, Kincardineshire. The apparatus was that of the Agricultural Electric Discharge Co., Ltd., consisting of an interrupter, induction coil, and Lodge valves. The overhead installation consisted of a number of fine wires (the diameter is not stated) arranged 15 ft. apart, and alternately bare and cotton-covered; these wires were about 11 ft. from the ground at the centre and 15 ft. near the supports. The experimental area consisted of ten plots, each 0·56 acre, half of each plot being electrified and half used as a control; the control areas lay south-east of the electrified ones. In 1914 a galvanised-wire netting (½-in. mesh) was placed between the electrified and control areas. A five-course rotation was followed (turnips, barley, hay, potatoes, and oats), and the ten plots were so arranged that in each season "two whole plots were under each of the crops of the rotation." In 1917 the treated barley showed an increase in grain of 31 per cent. over the control, but this result was not obtained in other years, and the general conclusion is arrived at that no persistent improvement was obtained in any of the crops grown.

These careful experiments show clearly the necessity for caution in this type of work, but, unfortunately, they do not advance our knowledge of the subject. In investigations on electro-culture there are two main aspects, the agricultural and the electrical; in these experiments, however, while the agricultural conditions have been carefully considered, the electrical conditions have been treated with comparative neglect. The information is given that the apparatus was capable of giving a current at 60,000 to 100,000 volts, but no measurements appear to have been taken of the actual voltage employed or of the discharge current from the wires, and no data are given as to the number of hours, or the time of day, during which the discharge was employed. The experiments were certainly a failure, but we cannot say under what electrical conditions the failure occurred. It is thus impossible to repeat the experiments or to compare them with experiments in which more successful results have been claimed.

IRON-ORE OCCURRENCES IN CANADA.

THE Canadian Department of Mines has just issued the second (final) volume of a report upon iron-ore occurrences in Canada by Messrs. E. Lindeman and L. L. Bolton. The first volume contains an account of the principal operating mines that may be considered active producers of iron-ore, and the second volume gives brief descriptions of a very large number of occurrences, some of which have been worked in the past, but are not now contributing to the output, whilst others have not been attacked. A considerable number of more detailed memoirs, such as those on the iron-ore deposits of Nova Scotia, on the Wabana iron-ore of Newfoundland, etc., have already been published by the Department of Mines, but the present work is particularly useful, as it not only summarises these, but also describes a very large number of occurrences about which no information has hitherto been available. A very useful feature, too, is the very complete series of references to any previously published descriptions of the mines or occurrences. Another, to which attention may with advantage be directed, is the large number of magnetometric maps that accompany the present report. It is pointed out in the introduction that particular attention has been devoted to these magnetometric methods, which have hitherto been but rarely employed outside Scandinavia, where they originated, because it is desired to impress the value of this method of working upon Canadian mining engineers, since definite information can thus be obtained as to the size, shape, and distribution of deposits of magnetite, while magnetometry provides a permanent record that will serve as a guide in the further exploration or development of these deposits.

BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

THE British Science Guild has carried out successfully a very useful enterprise in the British Scientific Products Exhibition, which was opened by Lord Sydenham, president of the Guild, on August 14, at King's College, London. The exhibition contains many examples of products and appliances of scientific and industrial interest which, prior to the war, were obtained chiefly from enemy countries, but which are now produced in the United Kingdom. It is an impressive reminder to all of the great advance made in the production of articles of prime importance for the home and foreign markets hitherto obtained from other countries. The exhibits cover a wide range, and include chemical products and processes, physical and electrical appliances, optical apparatus, measuring and mechanical instruments, surgical, bacteriological, and pathological appliances, including X-ray apparatus, etc. In practically all the sections the degree of progress indicated by the exhibits is surprisingly great, and even where no striking development has occurred in the way of new invention, there is noticeable a marked general improvement in apparatus constructed on the recognised lines of pre-war days.

Interest naturally centres round those exhibits associated with aircraft production. Here the developments and the differences between present-day aeroplanes and those of a few years ago are clearly marked. Modern spars, for instance, are much stronger for a given weight, engines have been developed as regards both material and construction to the extent of reducing their weight by more than one-half, whilst the size and power have grown enormously and are still making advances. The metallic materials which have been produced since the outbreak of the war, and of which aircraft constructors have been able to avail themselves, have made it possible for the greater part of an aero-engine to be made of light alloys. In non-metallic materials the investigation of timber has led to some interesting results. With regard to the many fittings which go to make up the complete aeroplane, one item of outstanding interest is the magneto. Before the war the Germans had practically a monopoly in the manufacture of this article for both car and aeroplane use, the Bosch magneto undoubtedly being the most popular throughout the world. The war has changed that, and the British manufacturers have seen to it that the home-built magnetos are worthy of their name. There are now nine British firms engaged in this work, with the result that during the past four years 300,000 magnetos have been manufactured for war service alone. What is equally important is that the home-made magneto is now as good as, or even superior to, the previously imported Bosch machine. The development of dope for the fabric of aeroplanes has been the subject of many investigations, and the planes of the present-day machine are rendered taut and weather-proof by means which, though slightly more complicated than varnishing, are many times as efficient. The British dopes consist of a solution of cellulose acetate made from paper or some cheaper form of cellulose, or of guncotton dissolved in suitable solvents and diluted in order to reduce the solution to a workable viscosity.

Another direction in which this country was largely dependent on Germany and Austria was in carbons for arc lamps. Fortunately, one British firm undertook the manufacture of such carbons, and through its foresight and enterprise we are now in a position to be self-supporting in this direction also.

During the war much progress has been made in the manufacture of insulation and of resistance wires, both of which were largely imported from Germany. The same is true of electro-medical apparatus. The examples of these displayed at the exhibition show that British manufacturers are capable of supplying our needs and of producing thoroughly sound products. We may pass over the interesting display which furnishes a fine example of successful British production on scientific lines of instruments of a high standard, and of the exhibits of refractory materials, in which direction progress has been very marked during the past four years. This is another industry which has been established here; and with proper care British manufacturers should be able to maintain their positions in this trade after the war.

Before the outbreak of war lens-grinding machinery was either made by the individual user or imported from abroad. Now such machinery, at least equal to any imported machines, is available in sufficient variety to cover all the ordinary types of work. At the same time entirely new methods of working glass have been developed and brought into ordinary use. Some of these methods are particularly well adapted to the manufacture of standardised optical systems. The most striking development in this respect has been the way in which enormous numbers of prism binoculars, sighting and other small telescopes, have been made to meet the demands of the military and naval authorities.

The gradual awakening of the British glass industry since the early days of the war, as revealed by the exhibition, is a feature which deserves particular mention. The two immediate needs were chemical glass and optical glass. Let it be said to the credit of British industry that in regard to optical glass a well-known British firm near Birmingham started the manufacture of this in 1848 and kept it alive at considerable pecuniary sacrifice. Since the outbreak of war this firm's output has increased twenty-fold. Up to nine months after the outbreak of war there was no general and active movement among manufacturers to take up new work. Since then steps have been taken to speed up glass manufacture in general, and from the beginning of 1916 the trade has rapidly progressed from a state of dependence or doubt to one of determined optimism. The exhibition provides some measure of the material results of the reawakening of the glass industry in this country.

The Munitions Inventions Department of the Ministry of Munitions exhibits some of the results which have accrued from the research undertaken on the nitrogen problem. This takes the form of a unit plant for the oxidation of ammonia to oxides of nitrogen. This process was not in extended use outside Germany before the outbreak of war, but there is reason to believe that the Germans have relied on it very largely for their output of nitric acid for explosives, as well as in the manufacture of sulphuric acid by the chamber process, as a substitute for Chile nitrate, which, owing to our blockade, they have been unable to obtain. The method is now in use in this country, and several large firms, such as Brunner, Mond, and Co., Ltd., and the United Alkali Co., Ltd., are using apparatus similar to that shown. The apparatus is on view continually during the period of the exhibition. Demonstrations are given by an officer of the Munitions Inventions Department on Wednesdays at 4.30 p.m.

In a preliminary review of the exhibits which will be displayed at King's College until September 7 it is difficult to do more than give an outline of the development which has been achieved under the pressure of war conditions. For instance, much can be said about the development of the dye industry, which was so backward in this country prior to 1914 that the outbreak of war disclosed a dependence on Germany for our supplies of dyes that was little short of appalling. The serious position in which we were placed is evident when it is realised that our trade in cotton and woollen goods, as well as the requirements for leather staining and a multiplicity of minor industries, could be carried on only with the aid of these essential materials. How the difficulties have been overcome and the dye industry and industries associated with it placed on a firm footing will provide a most interesting chapter in the industrial history of these days. What has been achieved can be seen at King's College, and is certainly worthy of attention. Dependent upon the dye industry is that of drugs and fine chemicals, and the progress made during the war has rendered the Empire self-supporting in regard to its supplies of these essential articles.

The aim of the exhibition is to stimulate public interest and confidence in the capacity of British science combined with industrial enterprise to secure and maintain a leading place among progressive nations; and the object is the full development of our mental and material resources. It has been popularly assumed that useful scientific work was almost a prerogative of Germany, whereas a slight acquaintance with scientific history would show that most modern industries have originated with British science and invention. In purely scientific research of initiative quality we have been the pioneers; where we have been deficient is in the practical use of the results obtained and the application of our natural scientific genius to the solution of industrial problems. In order to ensure that full use is made of our capacity in this respect in the future, it will be necessary to provide for the training and employment of many more scientific technologists than have hitherto been available in this country. The adequate supply of highly trained scientific workers and technologists is, indeed, a matter of the utmost gravity and urgency, and upon it undoubtedly depends the prosperity and safety of the country after the war, as well as the development of the natural resources of the Empire and the production of our industries on a scale greatly in excess of anything we have hitherto achieved. The Education Act has provided for elementary and continuative education by which the rank and file will be equipped for the struggles of the future, but from the point of view of industrial development it is even more important to secure a supply of highly trained captains of industry and pioneers of applied science. Modern progress in industrial and commercial fields depends upon these leaders, and the State that neglects the training of them in adequate numbers cannot expect to maintain a high place among the progressive Powers of the world.

THE ERUPTION OF KATMAI.[1]

THE Katmai expeditions of the National Geographic Society, under the leadership of the present writer, have been exploring the district devastated by the great eruption of Katmai in 1912. As knowledge of this eruption increases, it becomes more and more apparent not only that it was one of the greatest of all eruptions, but that it had many peculiarities which set it apart in a class by itself, without parallel in historic times.

Until the eruption in 1912 there were no definite records of activity in the Katmai district since the occupation of the country by white men, although the natives reported that some of the volcanoes "occasionally smoked." The district was so little known that, so far as can be learned, the volcano was never photographed before the eruption. Fortunately, however, its altitude was precisely determined and its configuration was roughly indicated by contours on the United States Coast and Geodetic Survey's chart of the district. Before the eruption the volcano was a three-peaked mountain rising nearly 7500 ft. above the broad valley of Katmai River, which stretched from the sea inland to the very foot of the mountains.

In the eruption the whole summit was blown away, and in its place was left an enormous crater. The preliminary explorations of the National Geographic Society's expedition of 1916 revealed the general condition of the volcano, and indicated that this crater was of enormous size. In 1917 the whole area was mapped on a scale of 1 : 250,000, following the methods and standards of the United States Geological Survey. This survey showed that Katmai is the largest active crater in the world, surpassing Kilauea, which had previously laid undisputed claim to this distinction, in every dimension. The comparative measurements are:—

	Katmai	Kilauea
Length...	3·0 miles	2·93 miles
Width ...	2·75 ,,	1·95 ,,
Circumference	8·4 ,,	7·85 ,,
Depth ...	3700 ft.	500 ft.
Cubage...	About 2·0 cubic miles	0·4 cubic mile

Because of its much greater depth, the crater of Katmai forms a much more awe-inspiring spectacle than that of Kilauea. The two are, however, so different in character that they are scarcely comparable. The bottom is occupied by a lake of hot water, through which emerges a single-breached cone, the remnant of the last spasms of the great eruption.

The violence of the explosion was so great that the whole of the tremendous mass thus thrown off the mountain was reduced to fine fragments. No rocks or cinders of large size are to be found anywhere among the *débris*. The largest piece of pumice observed among the ejecta from Katmai is less than a foot in its longest dimension. A further consequence of the violence of the eruption was the very wide distribution of the ejecta. On the crater-rim the depth of the deposit was only 45 ft., less than in many a minor eruption. But Kodiak, a hundred miles to the eastward, was covered by about a foot of ash, while appreciable falls, accompanied by the corrosive fumes of sulphuric acid, were detected so far away as Victoria, B.C., more than 1600 miles distant. World-wide atmospheric effects were also observed, but these were much less pronounced than after the explosion of Krakatoa.

But in the great mantle of ash and pumice thrown out over a wide expanse of country Katmai far sur-

Photo] [*D. B. Church*

FIG. 1.—Mount Katmai, the greatest of active volcanoes, after the eruption of 1912. The whole of the former three-peaked top was blown away in the explosion of June, 1912, and in its place is left an enormous crater three miles long, the rim of which forms the present crest of the mountain.

[1] Copyright in the United States of America.

passed Krakatoa. The study of the return of vegetation to these ash-covered areas was one of the primary objects of the expeditions, which have laid out about a hundred vegetation stations, wherein the progress of returning vegetation can be accurately observed. From some of these stations photographs and records have already been obtained for three years.

At Kodiak, and wherever the ash-fall was less than 2 ft., an abundant growth of plants has come up through the ashy covering from old roots, resulting in an almost miraculous recovery of vegetation. But where the ash-fall exceeded 3 ft. none of the old plants were able to penetrate the ashy blanket, although there is abundant evidence that they survived the fury of the eruption even on the slopes of the volcano itself.

There are, therefore, large areas which were denuded of both plant and animal life and rendered absolutely sterile by the eruption. These present an unparalleled opportunity for the study of the conditions necessary for the establishment of life on a raw mineral soil without humus or organic matter of any sort. In 1917 chemical and bacteriological studies of the condition of these soils were carried out by J. W. Shipley and Jasper Sayre respectively, in addition to the botanical investigations of the previous expeditions. The zoologist of the expedition, James S. Hine, made extensive studies of the animal life, especially the insect fauna, in the uninjured district to one side of the devastated area. It is expected that the results of these and other investigations will be issued in a series of technical papers to be published in the *Ohio Journal of Science* as soon as they are completed.

But the most sensational, as well as the most important, of the results of the expedition was the discovery of certain phenomena concomitant with the eruption of Katmai, which are even more interesting than the explosion itself.

The most striking of these is the Valley of Ten Thousand Smokes, which occupies an area of about seventy square miles north of Mount Katmai. Before the eruption this was a system of grass-covered valleys with no sign of volcanic activity. Now it is traversed by hundreds of fissures extending along its margin or criss-crossing its floor. These fissures are the seat of several millions of volcanic vents of all sizes, from great volcanoes pouring forth columns of vapour more than a mile high, down to minute jets of gas which pass unnoticed amongst their greater neighbours. This valley was discovered by the Geographic Society's expedition of 1916; but it was not possible to explore it until 1917, when its study was the principal objective of the party. Four weeks were spent within its confines in the past season; but it cannot be said that its study was more than well begun, so numerous and varied are its phenomena.

In the cataclysm by which the present condition of the valley was produced all traces of the vegetation which formerly clothed its sides were destroyed, so that there remains no wood for use as fuel or otherwise. But it was found that one of the small fumaroles furnished a very acceptable substitute for a cooking-stove. The whole area is so broken up and permeated with escaping vapours that it was impossible to find a cool spot for a campsite. A thermometer inserted in the ground 6 in. below the floor of the tent promptly rose to the boiling-point.

By analogy with other regions, it was expected that hot springs and geysers might be found accompanying the gas-emitting volcanoes, but such are altogether absent. The study of the conditions of the valley showed that their presence is impossible by reason of the high temperatures prevailing throughout the area. The vents are so hot that they would instantly vaporise any water that might reach their throats. The expedition, not expecting such high temperatures, was not equipped with the pyrometers necessary for their measurement. All the major vents were hot enough to boil mercury, but how much hotter they

Photo] [*D. B. Church*

FIG. 2.—A corner of the Valley of Ten Thousand Smokes. The "cookstove" at which the members of the expedition prepared all their meals is in the foreground.

are than that it is impossible to tell until further observations have been made.

Collections of the gases from the volcanoes were made for study by the Geophysical Laboratory of the Carnegie Institution. The conditions of emission are such that the valley offers a unique opportunity for the collection of volcanic gases without danger of contamination with the atmosphere. Samples from representative vents were taken, both in vacuum tubes and by pumping the gases through tubes filled with barium hydroxide. Observations on the ground were sufficient to indicate the presence of a considerable variety of gases. The vents likewise produce a great variety of solid deposits. These are of all colours of the rainbow, and represent a considerable diversity of chemical composition. Their study is likewise being prosecuted by the Geophysical Laboratory.

It is not possible, in advance of the completion of the analyses now under way, to give a definite statement concerning the chemistry of the vents. But the field observations on the volcanoes, on the temperatures of the vents, and on the character of their emanations and sublimations make it manifest that the Valley of Ten Thousand Smokes is not a superficial phenomenon due to the cooling off of a hot body of ejecta or some such circumstance. It is clear, rather, that its fumaroles are truly volcanic vents furnishing avenues of escape for an immense body of magma lying somewhere beneath the surface. What the relations of this mass of magma may be to the explosion of Katmai and to the geology of the country round about are problems which must await further study.

But while the phenomena of this district present a unique opportunity for the study of some features of volcanism not hitherto revealed, its remarkable character is destined to appeal to a wider circle than that comprised by scientific vulcanologists.

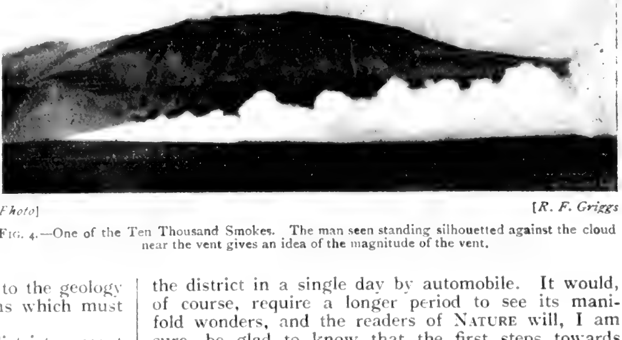
Photo] [*R. F. Griggs*

FIG. 3.—Novarupta Volcano. The column of dust and vapour from this great volcano, which has burst up through the sandstone floor of the Valley of Ten Thousand Smokes, often obscures the sky for miles around.

As a spectacle of the action of the grandest of all the forces of Nature, the Valley of Ten Thousand Smokes is so far beyond anything else known to us on the globe as to make it quite certain that it will rank as the first wonder of the world when once its remarkable features are understood by the public. For here, continually rising quietly from the ground without explosive action of any sort, is more vapour than is given off by all the rest of the world's volcanoes put together (except during a period of dangerous eruption). The majesty of the sight presented by its myriads of steam columns, gracefully circling up from the ground to mingle with the common cloud which habitually hangs over the valley, is a matchless and awe-inspiring spectacle. No pictures or descriptions, interesting as they may be, can convey the slightest conception of the beauty and magnitude of this wonder of wonders.

At the present time this Valley of Ten Thousand Smokes is so difficult of access that the only human beings who have ever set foot in it are the members of the National Geographic Society's expeditions. But this difficulty is due not so much to its remoteness from ordinary means of travel as to the generally primitive and unsettled condition of the part of the world in which it lies. Were means of transportation provided, it would be quite possible to land from an ocean liner in the morning and cover the whole of the district in a single day by automobile. It would, of course, require a longer period to see its manifold wonders, and the readers of NATURE will, I am sure, be glad to know that the first steps towards making it accessible are now being taken.

ROBERT F. GRIGGS.



Photo] [*R. F. Griggs*

FIG. 4.—One of the Ten Thousand Smokes. The man seen standing silhouetted against the cloud near the vent gives an idea of the magnitude of the vent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE have received a copy of the prospectus of the Merchant Venturers' Technical College, which provides and maintains the faculty of engineering of the University of Bristol, and we note that the courses include schemes of study for persons intending to engage in civil, mechanical, and electrical engineering. The department of automobile engineering has been closed for the duration of the war, as the professor of that department is doing important work in connection with munitions.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 29.—M. Ed. Perrier in the chair.—G. **Humbert**: Ternary indefinite quadratic forms.—J. **Boussinesq**: The fundamental formula of Tresca for punching a cylindrical block of lead.—G. **Bigourdan**: Delisle at the Hôtel de Taranne; Lalande, Bailly, and Coulvier-Gravier at the Luxembourg.—M. **Balland**: The use of lime-water in the preparation of munition bread. An account of some experiments made in 1917 by order of the Minister for War on the use of lime-water in bread-making.—P. **Bruère** and Ed. **Chauvenet**: Zirconium nitride. Starting with the ammonia compound of zirconium chloride, $ZrCl_4.4NH_3$, a rise of temperature gives successively the amide, $Zr(NH_2)_4$, the imide (impure), $Zr(NH)_2$, and finally, at about 350° C., the nitride, Zr_3N_4. This last appears to be the only nitride, and no evidence of the compounds Zr_2N_3 and Zr_3N_8 has been obtained.—M. **Verzat**: The measurement of temperature in very deep soundings. Two thermometers were cut at a temperature (40° C.) lower than that expected; after remaining at the bottom for an hour they were raised, and some mercury was found to have escaped. Comparison with a standard then showed the temperature (62·5° C.) at which the mercury exactly filled the tube, and thus gave indirectly the temperature at the bottom, 1616 metres from the surface. This gives a rise of 1° C. for every 32·3 metres depth.—F. **Morvillez**: The leaf-trace of the Cæalpine Leguminosæ.—H. **Colin** and Mlle. A. **Chaudun**: The law of action of sucrase. The deviation from Wilhelmy's formula is less marked as the ratio of saccharose to sucrase diminishes.—F. **Ladreyt**: Epithelial regeneration. Besides normal physiological renovation, epithelium may abnormally be regenerated at the expense of conjunctive tissue.—A. **Besredka**: Experimental paratyphoid fever B. The mechanism of immunity in paratyphoid B. Vaccination by the mouth.—H. **Bordier**: A radio-therapic unit of quantity. The unit is based on the amount of iodine set free from a 2 per cent. solution of iodoform in chloroform. It has been proved that the iodine liberated is regular, and proportional to the time of irradiation by the X-rays. The unit is then defined as the quantity of X-rays capable of setting free 0·1 milligram of iodine in 1 c.c. of a 2 per cent. solution of iodoform in chloroform, thickness 1 cm., and in the dark.—A. **Paine** and A. **Peyron**: Seminome of the testicle of the rabbit, with graft and generalisation to the second generation.

VICTORIA.

Royal Society, May 9.—Mr. J. A. Kershaw, president, in the chair.—G. F. **Hill**: Relationship of insects to parasitic diseases in stock. Part I. Life-histories of three nematode parasites of the horse, *Habronema muscae, H. microstoma*, and *H. megastoma*. Part II. Certain points in the life-history of *Melophagus ovinus*, the sheep "louse-fly" or sheep "tick."—F. **Chapman**: Ostracoda from the Upper Cambrian Limestone of South Australia. Three new species of Leperditioid Ostracoda are described from the Archæocyathina Limestone of Curramulka, namely, *Leperditia tatei, L. capsella*, and *Isochilina sweeti*. *L. tatei* has its nearest analogue in *L. anna* of the Upper Cambrian of St. Ann's, Canada, whilst *L. capsella* bears a certain resemblance to *L. canadensis* of the Canadian Lower Palæozoic. The species of Isochilina is of large size (length more than 7 mm.), and has a general resemblance to some forms of Aristozoe (cephalic region), but is a true Ostracod from its swollen proportions and thickly calcified carapace.

BOOKS RECEIVED.

Studies in Electro-Pathology. By A. W. Robertson. Pp. viii+304. (London: G. Routledge and Sons, Ltd.) 12*s*. 6*d*. net.

Wealth from Waste. By Prof. H. J. Spooner. Pp. xvi+316. (London: G. Routledge and Sons, Ltd.) 7*s*. 6*d*. net.

Sir William Ramsay. By Prof. T. C. Chaudhuri. Pp. ix+66. (Calcutta: Butterworth and Co. (India), Ltd.) Rs.1.8 net.

On the Determination of the Principal Laws of Statistical Astronomy. By W. J. A. Schouten. Pp. 128. (Amsterdam: W. Kirchner.)

Modern Dyeing Methods. By C. M. Whittaker. Pp. xi+214. (London: Baillière, Tindall, and Cox.) 7*s*. 6*d*. net.

Industrial Electrometallurgy, including Electrolytic and Electrothermal Processes. By Dr. E. K. Rideal. Pp. xii+247. (Baillière, Tindall, and Cox.) 7*s*. 6*d*. net.

The Science of Health and Home-making. By E. C. Abbott. Pp. xv+302. (London: G. Bell and Sons, Ltd.) 3*s*. 6*d*. net.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

THURSDAY, AUGUST 29, 1918.

ITALIAN GEOLOGY.

(1) ***Bibliography of the Geology and Eruptive Phenomena of the More Important Volcanoes of Southern Italy.*** Compiled with the assistance of Madame A. Johnston-Lavis by Prof. H. J. Johnston-Lavis. Second edition, completed after the author's death by Miss B. M. Stanton and edited with a preface and short life of the author by B. B. Woodward. Pp. xxiv+374. (London: The University of London Press, Ltd., 1918.)

(2) ***Italian Mountain Geology.*** By Dr. C. S. Du Riche Preller. Part i. *The Piémontese Alps, Ligurian Apennines, and Apuan Alps.* Pp. 1–99. Part ii. *The Tuscan Subapennines and Elba.* Pp. 101–92. (London: Dulau and Co., Ltd., 1918.) Price 2*s.* 6*d.* net each.

(1) THE late Prof. H. J. Johnston-Lavis was an untiring worker, and the bibliography now so handsomely published is a monument to the thoroughness with which his studies were pursued. The Italian volcanoes, on account of their position in the heart of Mediterranean culture, and their consequent accessibility to every inquiring pilgrim who made his way to Rome, have formed, almost unaided, the foundation of the science of vulcanology. Sir William Hamilton, our Ambassador at the Court of Naples at the close of the eighteenth century, brought systematic and continuous observation to bear upon the phenomena of Vesuvius. Spallanzani, very little later, undertook the description of Sicily. The contemporaneous and acute researches of Faujas de Saint-Fond among the extinct volcanoes of France owed their influence on geological thought to the author's comparisons of chilled materials with the products of active cones in Italy. Werner of Freiberg, the exponent of cabinet geology, was defeated when his pupil von Buch travelled southward of the Alps. The bibliography of South Italian volcanoes, as we look back on memorable controversies, is indeed a conclave of great names. If we could rearrange the papers cited in the order of their dates, instead of the far more convenient author-system here employed, we should have a history of alarm and wonder-seeking, passing into more or less sober speculation, and finally into patient observation varied by exciting episodes.

The division of the subject in this work into papers on various areas has led to a repetition of many entries. This could have been avoided if each entry had been numbered and a cross-reference made when requisite. This matter is worth mentioning, since the repeated references have very different bibliographic values. That to the famous "Campi Phlegræi," for example, under "Hamilton" in the section on the Æolian Isles is far better than the previous one in the section on Vesuvius. The Æolian reference to "Der Aetna," by Sartorius von Waltershausen (edition of 1880), is, on the other hand, less satisfactory than that given later under Etna. This finely printed work is of value to all geologists and also to all public libraries. It contains, moreover, a characteristic portrait of the compiler, standing among the Vesuvian tuff-beds, as some of us remember him in 1906, a year highly memorable in the history of the mountain that he loved.

(2) Dr. Du Riche Preller's collected papers on the structure of western and north-western Italy are the result of much close observation in the field and of careful consideration of the published work of others. After each descriptive exposition, the author states his own conclusions, and the numerous references, given as footnotes, render it easy to pursue any controverted point in detail. He reasons that the marble of Carrara (p. 96) is of Triassic age, since it has none of the schistose character of the Alpine Permian. He furnishes interesting remarks on the *pietre verdi* of various types, assigning them generally to submarine basic eruptions, dating from Palæozoic to Eocene epochs. The penetration and overriding of Mesozoic rocks by granite in western Liguria are attributed to intrusion in Cainozoic times, rather than to transport of the crystalline rock by overthrusting. The more extreme movements demanded by Termier are viewed with some suspicion. The tone of the papers is far from controversial, and the bringing together of so much matter of diverse interest is distinctly helpful to geologists. We do not know why the author prefers "Piémont" to the English form, and he certainly must not be allowed to use "euphodite," as he does quite consciously, for "euphotide." The term is due to Haüy and not to Delesse (p. 24), and we must not forget its author's charming explanation—"parce que le fond de la roche réfléchit le blanc . . . et que le diallage réfléchit tantôt le vert, qui est la couleur amie de l'œil."

GRENVILLE A. J. COLE.

THE GROWTH OF SCIENCE.

An Introduction to the History of Science. By Prof. W. Libby. Pp. x+288. (London: G. G. Harrap and Co., Ltd., 1918.) Price 5*s.* net.

WE cordially recommend this book to the general reader as well as to educable teachers and students of science. It is admirably written, the work of a scholar and thinker who knows the value of restraint. By careful selection of his illustrative material, and by aiming, not at a chronicle, but at an exposition of the great factors in the development of scientific thought, he has succeeded in giving us a really useful *short* history of science. With what Prof. Libby says in his preface regarding the educative value of school instruction in the history of science we are in entire agreement, and he has supplied the introductory book that was wanted. It helps us to realise how the sciences have grown up, that they continue growing, that their growth has had instructive vicissitudes, that their development depends on social as well as on personal factors, that they are democratic and international, and that they develop inter-linked with one another.

The scope of the book may be briefly indicated. The banks of the Nile, the Tigris, and the Euphrates saw many interesting beginnings, *e.g.* in astronomy and medicine, for the most part oriented to practical needs. The deepening influence of abstract thought, often linked to observation and experiment, is illustrated by Thales, Pythagoras, Plato, Euclid, Aristotle, and Archimedes. The Roman practical and regulative genius is illustrated by Vitruvius, with his fine conception of the synoptic dignity of architecture, and we are led on to Pliny the Elder and to Galen. An instructive chapter on the continuity of science through the Middle Ages is followed by a discussion of the classification of the sciences, Bacon's in particular. The development of scientific method is illustrated by the work of Gilbert, Galileo, Harvey, and Descartes; and the fundamental importance of measurement by the achievements of Tycho Brahe, Kepler, and Robert Boyle.

The story of the Royal Society is the diagram of co-operation in science; the early development of geology illustrates the value of interaction; in a vivid chapter Benjamin Franklin is taken as representing the eighteenth century in its struggle for intellectual, social, and political emancipation; the relation of science and religion is discussed in connection with Kant and the astronomers; Dalton and Joule illustrate the reign of law; Sir Humphry Davy is pictured as an ideal man of science; scientific prediction finds its classic illustration in the discovery of Neptune; the stimulus that travel gives to science is typified by Darwin's Columbus-voyage; the relief of man's estate by scientific discovery has its fine examples in the work of Pasteur and Lister; science as the mother of inventions is exemplified by the Langley aeroplane. Such are the subjects of successive chapters of a fascinating story, which ends with discussions of scientific hypotheses, scientific imagination, and the relation of science to democratic culture. Our only serious criticism is that the book takes relatively little account of biological science.

WHALE-FISHING.

Modern Whaling and Bear-hunting. A Record of Present-day Whaling with Up-to-date Appliances in Many Parts of the World, and of Bear and Seal-hunting in the Arctic Regions. By W. G. Burn Murdoch. Pp. 320. (London: Seeley, Service, and Co., Ltd., 1917.) Price 21*s*. net.

THE literature of the whale-fishery is large, and there is much delightful reading to be found in it. Scoresby still stands first and foremost; he had the true scientific eye, he told us just what he saw, and we go to his books to read not only of whales, but also of snow-crystals, and the heights of waves, and a multitude of other things that many have seen and few recorded. But Scoresby was a little apt to be incredulous of the things he had not seen, and so it happened (for instance) that he led naturalists astray for half a century by declaring that there was no such thing as a "Basque whale." We have also the old books of Martens and of Zorgdrager, and many older accounts than these, from the days of Baffin and of Edge and his Muscovy Company. And, besides all these, we have a long series of narratives, more or less exciting, of whaling voyages for the last hundred years and more, Colnett and Bennett and H. J. Bull, and many others, not forgetting among the older ones the Commandeur Frederik Pietersz's voyage to Greenland "op het Schif De Vrouw Maria," nor among the latest the romantic story of the "Cruise of the *Cachalot*."

To all these Mr. Burn Murdoch has now added another, to tell of "modern whaling" in many seas, north and south and round the world; and he weaves into the story of his own adventurous voyages a lively account of the growth and recent origin of this extensive and prosperous industry. The reader may learn here, for instance, how old Svend Foyn spent years and years on the perfecting of his "harpoon-gun," and the planning of the little swift ships from which it was to be used; how, when all was complete, the great Finner whales and humpbacks, which had lived an innocent and unmolested life since the world began, were harried from sea to sea, and boiled down into oil and ground up into bone-meal and cattle-food; how the whale-oil is "hardened" into "white, tasteless, edible fat excellent for cooking purposes," and how sensible men eat the whale-beef and find it excellent; and how Svend Foyn became rich thereby beyond the dreams of avarice, and his little town of Tonsberg, where his statue stands, became an important place and a busy centre of commerce and industry.

The book is a gossipy one; it roves from one theme to another; it is full of stories, and some few of them (perhaps the usual small proportion) are good; and, better than the stories, it brings to our ears, for once in a way, the tune of some fine old lively chantey, like "Blow, ye winds, hey ho, to California." Every now and then, among the lighter stuff, Mr. Burn Murdoch lets us see that he is a shrewd observer, and better still, that he can, when he pleases, write very admirable English. Best of all, to our thinking, are some of his descriptive bits of really fine word-painting: as, for example, of the "rich, colourful light of the Gulf Stream, that seems to increase south and westerly as you follow it, say, from the west of Kirkcudbright to Spain, and westwards till you come to the Sargasso Sea"; or, again, of "that jewel of a Sea-town," Ponte Delgado, San Miguel in the Azores. D. W. T.

OUR BOOKSHELF.

Dynamic Psychology. By Prof. R. S. Woodworth. (Columbia University Lectures.) Pp. 210. (New York: Columbia University Press; London: Humphrey Milford, 1918.) Price 6*s*. 6*d*. net.

THIS short course of lectures is designed to give an account of the distinctive character of the modern movement in psychology. It provides a sketch of the historical development of the science, and shows the revolution it has undergone, as essentially a part of, and determined by, the general revolution in the whole conception of modern science which has followed the abandonment of the geocentric point of view. Psychology is the youngest of the empirical sciences, but in none has the revolution been more marked and rapid. This is due to the fact that only in very recent times have we come to recognise that psychology is something more and other than a chapter in general philosophy, that it has for its subject-matter a class of empirical facts as distinct, as obstinate, and as capable of being abstracted for the purposes of special study as the facts with which physics and biology deal. Prof. Woodworth sees the real beginning of modern psychology in John Locke and the English empiricist philosophers. Its notable advance in recent times, and the complete change it has undergone, are mainly due to the discernment of the significance of the facts revealed in abnormal psychology, and also to the study of the instinctive basis of human nature. The "drive" and the "mechanism" are the two factors which mutually condition one another, and it is the object of the modern psychologist to discover their true nature and relation in order to lay the foundations of a practical or applied science. Although the lectures make no pretension to add anything to our theoretical or practical knowledge, they are very valuable as indicating the new conception of the much-debated scope and method of psychology.

H. W. C.

Aids in the Commercial Analysis of Oils, Fats, and their Commercial Products: A Laboratory Handbook. By G. F. Pickering. Pp. viii + 133. (London: C. Griffin and Co., Ltd., 1917.) Price 7*s*. 6*d*. net.

THIS is a book intended for the works chemist who has to deal with oils, fats, and their products as raw materials for his industry. The author does not treat of the elements of his subject, but writes for those already engaged in the examination and utilisation of fatty substances. A good deal of sound practical advice is given, such as, for instance, the directions for taking samples of materials to be examined. Bad sampling, it is truly said, has caused far more differences between buyer and seller than the use of different methods of analysis.

The book includes a useful collection of analytical methods suitable for employment in works laboratories. The author remarks that all the figures [numbers] given "are now published for the first time." This, however, is not necessarily a recommendation unless they cover a sufficiently wide range of examples to be truly representative, and not much is said on that point. The section on fat "splitting" (*i.e.* decomposition into glycerol and fatty acids) is one of distinct value, as are also those on glycerine, resins, and recovered products.

In a work of this kind the facts are the important things, but it may be pointed out, without hypercriticism, that the author is occasionally a trifle careless in his expression of them. Thus (p. 8) we are told that a certain distillation had been "performed by dissolving resin in the oil," which does not quite convey the idea intended. On p. 87 there are directions to "drop in a little sulphuric acid (34·7 c.c. of concentrated acid and 37·5 c.c. of water)," which again must not be taken too literally. The expression "ethyl ethers," too, where esters of fatty acids are meant (p. 89), is not very accurate—or, at best, is antiquated. These, however, are minor blemishes. The book, as a whole, is a very practical and useful aid to the technical chemist.

Natural Science in Education. Being the Report of the Committee on the Position of Natural Science in the Educational System of Great Britain. Pp. viii + 272. (London: Published under the authority of His Majesty's Stationery Office, 1918.) Price 1*s*. 6*d*. net.

THE report of the Committee, of which Sir J. J. Thomson was chairman, appointed by Mr. Asquith in August, 1916, to inquire into the position occupied by natural science in the educational system of Great Britain, especially in secondary schools and universities, was reviewed in our issue of June 6 last (vol. ci, p. 265), and it is unnecessary to emphasise its importance again. We welcome the opportunity, however, of directing attention to its republication in convenient book form, which will make it possible to have the report among one's reference volumes easily accessible for constant use. It may be hoped that all future important Government reports may be issued in a similar style, for they will be much more likely to be studied than if printed on the old familiar foolscap sheets.

Chemistry for Beginners and School Use. By C. T. Kingzett. Third edition. Pp. 211. (London: Baillière, Tindall, and Cox, 1918.) Price 2*s*. 6*d*. net.

THE first edition of Mr. Kingzett's little book has been reviewed already in these columns (vol. xcix, p. 422). The opportunity provided by the demand for a new edition of the book has been taken to add an additional part, illustrated by eighty-one figures, dealing with chemical apparatus and experiments. Originally the volume was planned to give an introduction to chemistry to beginners having no opportunity to witness or perform experiments, yet it may be doubted if the addition of the new part will render the book sufficiently practical for use in most schools where chemistry is studied.

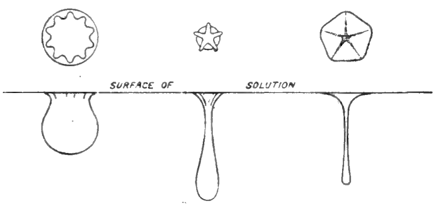
LETTERS TO THE EDITOR.

[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.]*

Production of Medusoid Forms from Gels.

THE reference to the phenomena of ordinary drops in Prof. D'Arcy W. Thompson's letter on "Medusoid Bells" in NATURE of August 8 has suggested to me the possibility of obtaining permanent imitations of such forms as he describes by producing drops of gelatin in a suitable medium. The latter must be one of the solutions which harden gelatin, must have a specific gravity very near that of the gelatin sol at the temperature at which it is used, and must possess an appreciable interfacial tension against the sol. I have found that a solution of aluminium sulphate can be made which fulfils all these conditions.

If 20 per cent. gelatin sol, which may be coloured with any convenient dye, is dropped into such a solution from a tube about 4 mm. diameter, with its orifice from 2 to 8 mm. above the surface, rather interesting forms are obtained. The specimens do not lend themselves very well to photographic reproduction, but I have drawn diagrammatically three typical cases. In all instances the crenated or stellate portion rests on the surface. With a 10 per cent. gelatin sol permanent vortex rings can be obtained, as well as discs with a thickened rim, rings with a cylindrical fringe, etc.



To approach more nearly to the conditions of the budding organism, it would be necessary to discharge the drops below the surface of the liquid. This procedure entails some experimental difficulties, which, however, I hope to overcome. The forms so far produced do not show to me any evidence of vibration, but appear to be completely explicable by the effects of surface and interfacial tension and of the removal of water from the gel. Further experiments may show such evidence, and it would be very interesting if they could furnish support for so attractive a hypothesis in view of its two *prima facie* difficulties: the origin and the persistence of vibration in a medium with the peculiar elastic properties of dilute gels. Perhaps the results described may induce others, more competent than I am to interpret their biological and morphological aspects, to make such experiments; the conditions may be varied in a great number of ways which will readily suggest themselves to anyone familiar with the properties of gelatin.

EMIL HATSCHEK.

10 Nottingham Mansions, Nottingham Street, W.1, August 16.

Formulæ for Tetrahedron.

PERHAPS some readers of NATURE may be able to tell me whether the following results are new:—

Let ABCD be any tetrahedron; BC $=a$, DA $=a'$, and so for the other edges; (BC) = dihedral angle of which BC is an edge, and so on; (aa') the angle between BC, AD, and so on; α, β, γ, δ the areas of the faces opposite A, B, C, D respectively. Then we have identically

$$aa' \cos(aa') + bb' \cos(bb') + cc' \cos(cc') = 0 \qquad \text{(i)}$$

$$aa' \cos(aa') \cos(\mathrm{BC}) \cos(\mathrm{AD}) + bb' \cos(bb') \cos(\mathrm{CA}) \cos(\mathrm{BD}) + cc' \cos(cc') \cos(\mathrm{AB}) \cos(\mathrm{CD}) = 0 \qquad \text{(ii)}$$

It is a known theorem, due to Steiner, that the four altitudes of ABCD are generators of the same hyperboloid. With the help of (i) and (ii) I have found that, taking ABCD as the tetrahedron of reference, the equation of Steiner's hyperboloid is, in volume coordinates,

$$aa' \cos(aa')\{\alpha\delta yz \cos(\mathrm{BC}) + \beta\gamma xt \cos(\mathrm{AD})\}$$
$$+ bb' \cos(bb')\{\beta\delta zx \cos(\mathrm{CA}) + \gamma\alpha yt \cos(\mathrm{BD})\}$$
$$+ cc' \cos(cc')\{\gamma\delta xy \cos(\mathrm{AB}) + \alpha\beta zt \cos(\mathrm{CD})\} = 0.$$

In these formulæ certain conventions have to be made in the definitions of the angles (aa'), etc., so as to make the cosines come out with the proper signs.

Another interesting result is that if V is the volume of the tetrahedron,

$$4\alpha\beta\gamma\delta\{\cos(\mathrm{AB})\cos(\mathrm{CD}) - \cos(\mathrm{CA})\cos(\mathrm{BD})\} = 9\mathrm{V}^2 aa' \cos(aa')$$

with two other identities derived from this by interchange of letters.

All the formulæ can be translated into vector identities; thus $\Sigma aa' \cos(aa') = 0$ corresponds to the quaternion identity

$$\mathrm{S}\{(\beta-\gamma)\alpha + (\gamma-\alpha)\beta + (\alpha-\beta)\gamma\} = 0,$$

but the others do not seem to me to be so easily derivable.

G. B. MATHEWS.

7 Menai View, Bangor, August 17.

Rotating Discs.

A NOTE in NATURE, August 22, p. 491, referring to a recent article by Mr. H. Haerle, says: "The problem of ascertaining the distribution and magnitudes of the stresses in a revolving disc by means of mathematical formulæ is tedious and complicated. With the exception of the cases of discs of constant thickness and constant strength, for which definite integrals can be found, the analytical solution involves highly complex equations, and the ultimate result is doubtful." May I point out that the ordinary approximate solution for the rotating circular disc of uniform thickness, whether complete or holed, involves only simple powers of the radius vector? The corresponding solution for the thin elliptical disc involves expressions of an equally elementary type, though naturally longer. But in addition we have possessed for more than twenty years (see Proc. Roy. Soc., vol. lviii., p. 39) a complete solution for an ellipsoid of any shape rotating about a principal axis. This involves only simple powers of the variables x, y, z, and it applies, of course, to discs of very varied shapes. All the ordinary elastic solid equations, whether internal or external, are exactly satisfied in this case. Thus the uncertainties are only those inevitable through the difference between the ideal elastic solid problem and its realisation in practice.

C. CHREE.

August 26.

LORD BALFOUR'S COMMITTEE AND THE CHEMICAL TRADES.

AMONG the many subjects dealt with by Lord Balfour's Committee on Commercial and Industrial Policy after the War, in the attempt to grapple with the first term of their comprehensive reference, viz. "What industries are essential to the future safety of the nation, and what steps should be taken to maintain or establish them?" was that of the chemical trades. Unfortunately, these trades were not very adequately represented on the Committee, and there was practically no one member of it who was able to speak from his own knowledge of much that is comprised within so wide-embracing a phrase. It is significant of the Committee's attitude towards what they apparently regarded as a subordinate and relatively unimportant section of our staple industries that its consideration is dealt with only when that of all the others had been disposed of. This may possibly be accounted for by the circumstance that in all the other cases the members had before them reports from Sectional Departmental Committees appointed to consider the special circumstances of particular industries and to embody their findings in recommendations with which it was the function of Lord Balfour's Committee to consider further with the view of arriving, if possible, at a consistent and uniform commercial and industrial policy. Although the Committee alludes to memoranda from the National Health Insurance Commission and from the Pharmaceutical Society and War Office with respect to certain drugs, mainly for Army use, there is nothing in the final report to show that it had any opportunity of considering any similar reports of Sectional Committees representing the various divisions of the chemical trades. This is greatly to be regretted.

The subject of the present and prospective position of the chemical trades of this country, in view of their essential importance to the future safety of the nation, cannot be said to have been adequately considered as yet by any properly constituted body or bodies. Partial attempts have been made to deal with pressing difficulties arising from the shortage of dyes and drugs at the beginning of the war by a sort of hand-to-mouth policy. The enormous development of the manufacture of oil of vitriol required for the making of munitions has occasioned some perturbation of mind among those who are concerned with the future of the industry after the war, and a special Committee has considered and reported upon the matter. But as yet there has been no such collective action in the case of the chemical trades as we have seen in the case of the coal trade, the iron and steel trades, the engineering trades, in shipbuilding and marine engineering, the electrical trades, the trade in non-ferrous metals, and the textile trades. This, perhaps, may be partly due to the very diverse character of the industries which are comprised within the term "chemical trades," but these are not more diverse than those comprehended by that of the textile trades. Certain of these chemical industries are, no doubt, very small in point of output, and are represented by few firms of wealth or political influence. Some of these firms would unquestionably be enlarged, their number increased, and the variety and range of their products extended, if the Legislature could be induced to make up its mind with regard to the future commercial and industrial policy of the Empire after the war; but so long as all is uncertain, and the Government waits on events, or is moved only by party considerations, capital will not be attracted towards the development of industries which may at any time be crushed by the relentless and unscrupulous methods of German combinations, protected and encouraged by an equally relentless and unscrupulous Government.

Although Lord Balfour's Committee has dealt with the question of the position and future prospects of the chemical trades, in regard to the future safety of the nation, in a very imperfect and inconclusive manner, it must be admitted that the Committee has been accurately informed of much that is, unfortunately, only too true concerning their past history, and the report contains much plain speaking in regard to the lack of enterprise and originality which British chemical industry, especially in a number of the smaller trades, has hitherto manifested. Lord Balfour and his colleagues are under no illusions as to the sources of Germany's strength in the chemical arts. Her exports of chemical products in 1912 were double those of the United Kingdom. In other words, starting from an almost insignificant amount, Germany, since she became an Empire, has doubled the chemical output of the nation which long regarded itself as the premier manufacturing nation of the world.

"The predominant position," it says, "of Germany in the world in these industries, and the remarkable progress made by that country in recent years, were due . . . mainly to the persistent and thorough manner in which scientific knowledge and research and business ability have been combined for the building up of a great and comprehensive industry." It points out that "for synthetic dyestuffs the dye-using industries, and in particular the textile trades, of the world were dependent upon a group of very powerful German companies, which to great technical ability and financial resources added a most effective marketing organisation. Closely related to the dye-making industry was the manufacture of synthetic drugs, in which again Germany dominated the world. In fine chemicals . . . and a wide range of other chemical products, the German industry occupied an almost equally strong position. The large scale," it adds, "on which the German industry operated, the great technical ability at its disposal, and its very elaborate organisation, made it possible to market its produce at a price with which British manufacturers could rarely effectively compete, and facilitated the frequent adoption of a policy of systematic 'dumping,' with a view to the prevention of the development of competitive industries elsewhere." And then follows this humiliating admission:—"In numerous cases, both in respect of the classes of commodities already mentioned, and in *heavy chemical trades also, British manufacturers had found it necessary, in order to* *retain some part of the trade, to enter into agreements with their German competitors, and existed in some cases only on sufferance."*

There must be "something rotten in the State" that brings a proud and powerful nation to such a pass as this. The Committee, in its "General Conclusions," points out how we have allowed certain branches of production of great importance as a basis for other manufactures to come entirely or very largely under German control, and it enumerates many examples which have been made painfully familiar to us since 1914. "In all these cases the strength of the German position was due largely to persistent scientific work and organising skill." It might have been added that this "persistent scientific work and organising skill" was directed by a "commercial and industrial policy" deliberately designed to strike at the welfare and even at the very existence of this Empire.

Much of all this has been said many times already, but if the country is to be thoroughly aroused to a sense of the jeopardy in which it stands now that Germany has unmasked herself, it cannot be said too often. In stating its convictions as to how the present position has been brought about, the Committee is also repeating a twice-told tale. It has been due to a number of causes. They are thus summarised in the report. First, the conservative influence of history and tradition, engendering a feeling of over-confidence in the maintenance of our position, and in the methods hitherto pursued, with but little recognition of the necessity for constant vigilance and constant effort to meet the changing conditions and requirements of world trade. Secondly, the admitted success in many directions of the competition of Germany with the United Kingdom was due in part to the comparatively late entrance of German industry into the field; that economic conditions in Germany made cheap production possible; that she started with all the advantages of completely modern equipment and without the handicap of a traditional organisation. Lastly, that,

> from the first there was in Germany complete recognition of the great value of the application of science to industry and the close co-operation of the two; this, though most strikingly exemplified in the chemical trades, may fairly be said to be characteristic of German industry as a whole. Amongst British manufacturers, though there were some marked exceptions, there was, speaking generally, no such recognition.

It is admitted not only that the war has served to bring home to us the weakness of our economic position, but also that its requirements have roused us to an intensity of effort unparalleled in the industrial history of the nation, and in no branch has our potential power and productive capacity been more strikingly shown than in that of chemical industry. The Committee is glad to recognise that

> through British industry generally the cutting off of foreign supplies, of commodities hitherto regarded as indispensable and unobtainable except from abroad, has stimulated British manufacturers to efforts to fill the gap by the provision of similar commodities or adequate substitutes. In numerous directions attempts of this kind have been made, with and without Government assistance, to establish new lines of production of varying degrees of importance, and a substantial measure of success has already been attained in some cases . . . and the knowledge and experience gained during the war should be a most valuable asset in respect to our post-war trade.

In the special cases of drugs and dyes it is not only a question of competition with our enemies for a portion of the world's trade. Apart from the purely commercial aspect, these things are of vital importance to the health and economic life of the nation, both in war and in peace. It is absolutely necessary for our national welfare—nay, even for our very existence—that we should be no longer solely dependent upon outside sources of supply, and it is therefore the bounden duty of the Government to see that adequate steps are taken to ensure that such a consummation shall be reached. If individual enterprise is unable to secure it, then it must be the business of the State, in the interests of national security, to undertake its attainment.

SCIENTIFIC WORK IN INDIA.[1]

THE Board of Scientific Advice for India, the origin and functions of which were explained in these pages three years ago (NATURE, July 8, 1915), has, like similar bodies elsewhere, felt the effect of war conditions. The board has been strengthened by the addition of a representative of the Indian Munitions Board, and power has been conferred upon the president to appoint sub-committees, membership of which need not be confined to members of the board, for the purpose of dealing with particular investigations. The board has found it necessary to modify the treatment of programmes of work submitted by individual scientific departments, and to resolve that the annual report for 1916–17 be confined to a brief statement of work actually done during the year, also that the bibliography of publications bearing on particular subjects be consolidated. But the establishment of a Zoological Survey, recorded for the year under notice, has not affected the composition of the Board of Scientific Advice, representation of this subject having been provided for already. That its organisation should have been so slightly affected affords striking evidence of the soundness of the original constitution of the board.

The report of the board for 1916–17 is an interesting document, and much of its contents, especially where the applications of science are concerned, may repay perusal outside India. In agriculture the low values of available phosphate in certain Indian soils—at times only $\frac{1}{80}$ to $\frac{1}{20}$ of the amount usually regarded as necessary for fertility

[1] Annual Report of the Board of Scientific Advice for India for the Year 1916–17. Pp. 172. (Calcutta: Superintendent Government Printing, India, 1918.) Price 1s. 9d.

—have been under investigation. So, too, have been the low values of available potash in certain other soils. In this connection efforts have been made not only to correlate potash-deficiency with disease in animals and plants, but also to utilise the ash of at least one proclaimed weed as a means of adding potash to the soil, and incidentally as a partial set-off against the cost of eradication. Botanical work has included, in addition to survey operations, much that is of immediate economic importance. One notable instance is afforded by the device of a method of selfing cotton, which is not only simple, but is also said to have proved successful. Much sound work has been done with indigo, jute, opium, rice, sugar, and wheat on agricultural lines, and with grasses, as well as trees, on forestry lines.

On the physical side we find that researches in solar physics have included an investigation of the displacement of the lines of the solar spectrum compared with lines given by the electric arc. This study has supplied interesting results, and led further to a determination of wave-lengths in the spectrum of the planet Venus with results that are of promise. In geology, besides survey operations, useful economic work has been done in connection with the output of wolfram. Three new meteorite falls—all chondrites—have been reported for 1916–17 from northern India. The most notable item of economic geodetic work for the year has been the taking of hourly readings of a tide-gauge at Basra, erected in connection with military requirements. The constants deduced from the reductions of these readings have been transmitted to the National Physical Laboratory at Teddington, to admit of the tracing of tidal curves for 1917–18. Important also has been the compilation of a list of the plumb-line deflection stations of India and Burma.

The work undertaken in connection with plant- and animal-pathology has been useful and varied. In this relationship an item which deserves attention is an account of practical tests of the use of hydrocyanic acid gas for the destruction of vermin. While less successful than might be desired in the case of houses, this method has proved satisfactory as regards railway carriages and ships.

Appended to the report is a memorandum on work done for India at the Imperial Institute. A striking item in this memorandum is the record of a sample of Assam-grown flax, valued in London under war conditions in December, 1916, at 150*l.* per ton, which was found to compare favourably with the medium qualities formerly received from Belgium.

Perhaps the time is approaching when a body, similar in its functions to this Indian board, may be brought into being so as to ensure for the scientific departments of our various Crown Colonies that correlation of effort which, as this report testifies, already so happily attends the operations of the different scientific departments of the Indian Government.

PROF. PAOLO PIZZETTI.

ITALIAN geodesy sustained a serious loss by the death, on April 14, of Paolo Pizzetti, professor of geodesy in the University of Pisa. An account of Pizzetti's work is contributed to the *Atti dei Lincei*, xxvii. (1) 9, by Prof. Vincenzo Reina, and the following particulars are mainly derived from it.

Prof. Pizzetti was born at Parma in 1860, and at the age of twenty qualified in the Engineering School at Rome. He afterwards remained there as assistant to the Department of Geodesy at the time when Profs. Pisati and Pucci had commenced their researches on the absolute value of gravity. Prof. Pizzetti soon began to publish researches dealing with the determination of azimuth, conformal representation in geodesy, and similar subjects. In December, 1886, he was appointed professor extraordinarius of geodesy at Genoa, and while there devoted his main attention to the theory of errors, with special reference to combinations of observations. It was then that he produced his important papers on the results of a system of direct observations, published by the Royal Society of Liège, and on the mathematical foundations for the criterion of experimental results, the last-named paper appearing in the jubilee volume published in 1892 at the fourth centenary of the discovery of America by Columbus. We are indebted to Prof. Pizzetti for clearing up many points of doubt regarding the relative value of such concepts as measure of precision, mean error, probable error, and error of maximum probability. At the same time, he interested himself in the study of atmospheric refraction, on which he published papers dealing with the trajectories of light rays and the difficult problem of refraction in azimuth.

In 1900 Prof. Pizzetti removed to Pisa, and in the following year he took charge of the classes in celestial mechanics. He here initiated an important series of researches dealing with the figure of the earth and planets, and with Stokes's formula for the potential of a gravitating planet, of which he gave a rigorous proof. Previously some doubts existed as to the limits within which this expansion was valid, and these were set at rest by Prof. Pizzetti's investigation. It is scarcely surprising that he did not escape from the attractions of the ever-popular and seductive "problem of *n* bodies."

The bibliography at the end of Prof. Reina's notice enumerates ninety-two papers by Prof. Pizzetti, mainly devoted to geodesy, astronomy, and celestial mechanics, but including a few papers on pure mathematics and some reviews and articles of a more popular character.

To the present writer the name of Pizzetti will ever be associated with reminiscences of a day at Pisa at the conclusion of the Mathematical Congress of Rome in 1908, where it was his privilege to meet Prof. Pizzetti and his colleagues in friendly intercourse in the "Sala dei Professori," a room reserved for these informal gatherings at the Hotel Nettuno. It is true that we have professors' common rooms in this country, but there was a certain indefinable element about the "Sala dei Professori" which we seem rather to miss here.

G. H. BRYAN.

NOTES.

WE announce with deep regret the death on August 26, in a flying accident, of Prof. Bertram Hopkinson, C.M.G., F.R.S., professor of mechanism and applied mechanics in the University of Cambridge.

THE position of the company known as British Dyes, Ltd., appears to have been at last determined by the results of a meeting at Huddersfield, on August 21, at which the shareholders approved, by an overwhelming majority, a scheme for amalgamation with Messrs. Levinstein, Ltd., of Manchester. It will be remembered that British Dyes, Ltd., was the company formed in 1915 on the basis of the previously well-known firm of colour-makers, Messrs. Read Holliday and Co., and subsidised by the Government to the extent of a million sterling, with extra provision for research. There have been many expressions of dissatisfaction with the progress made under the original directorate, and the view has already been expressed in the columns of NATURE that the board required amendment by a larger representation of science in its composition. In the statement made recently in the House of Commons by Sir Albert Stanley this aspect of the question was not referred to, but the conditions laid down appeared to afford satisfactory guarantees that after the war there would be such a restriction of imports as to afford time for the struggling industry to be firmly established, while the dye users would be sufficiently protected as to both supplies and prices. There can be no doubt that the amalgamation when effected will have good results in putting an end to undesirable competition between the two companies and in bringing the operations at British Dyes, Ltd., under the influence of Dr. Herbert Levinstein's experience, which really amounts to giving science, as against pure finance, a more definite position in respect to the affairs of the company. The history of the origin and progress of the famous colour works of the Badische Company at Ludwigshafen on the Rhine has still to be written so as to be at once instructive and convincing to the British commercial world.

THE David Livingstone centenary medal of the American Geographical Society has, it is stated in *Science*, been awarded to Col. Candido Mariano da Silva Rondon in recognition of his valuable work of exploration in South America.

IT is announced in *Science* that Prof. S. J. Barnett has resigned his post as professor of physics at the Ohio State University in order to accept the position of physicist in charge of experimental work at the department of terrestrial magnetism of the Carnegie Institution of Washington. Prof. Barnett entered upon his new work at Washington on July 15.

THE Council of the Institution of Electrical Engineers has been in communication with the Ministry of National Service with reference to the utilisation, with due regard to their skill, of members of the institution called up for military service under the Military Service Act, 1918, No. 2. With the view of their being posted, so far as vacancies are available, to technical units, members of the new military age, on being called up for military service, are therefore invited to communicate with the secretary of the institution, who will supply them with the form and certificate approved by the Ministry for this purpose.

THE twenty-ninth annual general meeting of the Institution of Mining Engineers will be held at University College, Nottingham, on Friday, September 13, under the presidency of Mr. Wallace Thorneycroft. The Institution medal for the year 1917–18 will be presented to Mr. C. E. Rhodes. The following papers will be submitted: A Method of Determining the Magnetic Meridian as a Basis for Mining Surveys, T. Lindsay Galloway; The Chance Acetylene Safety-Lamp, W. Maurice; Recent Developments in the Coalfields South of Sydney, New South Wales, Dr. J. R. M. Robertson.

No. 10 of the *Berichte der deutschen chemischen Gesellschaft,* which has been published after some delay, contains the announcement of the death of Dr. Johannes Thiele, professor of chemistry in the University of Strasburg, at the age of fifty-three. Prof. Thiele first became well known by his work on nitro- and amino-guanidines, which opened up new methods of preparing hydrazine and hydrazoic acid, and secured for him an appointment as extraordinary professor at Munich. Here, as a result of Baeyer's work on the reduction of muconic acid, he took up the study of what were afterwards called conjugated double-bonds, and developed his theory of partial valencies, by which he was best known. Prof. Thiele was appointed successor to Fittig at Strasburg in 1902.

THE German Chemical Society has celebrated its jubilee by collecting a fund of 2½ million marks for the more extensive publication of chemical works of reference, such as Beilstein. We notice further, in a report of the annual general meeting, that an agreement has been concluded with the Verein deutscher Chemiker with regard to publications. The *Chemisches Zentralblatt* will deal more fully with technical chemistry, and will be available to the members of the latter society at a reduced rate. The *Berichte* will be subdivided, one section dealing with reports of meetings, notices, etc., the other containing the original scientific publications. The annual subscription to the German Chemical Society will become 10 marks, but will then only entitle members to receive the first of the above-named sections. A separate subscription will be required for the scientific section, as was already the case with the *Zentralblatt.*

DR. A. C. HADDON discusses in the August issue of *Man,* with numerous sketches, an anomalous form of outrigger-canoe attachment in use in the Torres Straits, and its distribution. The normal arrangement of connecting the float to the outrigger booms is in the Y form. This occasionally becomes modified into the V or U form. Some doubt still exists as to the origin and distribution of these modifications. But Dr. Haddon states that his "main object in compiling these notes is to emphasise how suggestive such an apparently insignificant feature as an outrigger attachment may be in the elucidation of the problems of distribution."

MR. T. SHEPPARD has reprinted from the *Naturalist* for July an account of a small but interesting exhibit of Bronze-age weapons from the collection of the late Cotterill Clark, now deposited in the Doncaster Museum. The specimens include a rapier-shaped blade, six spears, one flat axe, eight palstaves, three socketed axes, and a chisel, all from the eastern side of Doncaster, where, owing to the prevalence of fen bogs, such objects would be likely to be lost. One of the palstaves is of a somewhat unusual pattern, those with a transverse edge; as Sir J. Evans remarked: "Palstaves of the adze form, having the blade at right angles to the septum between the flanges, are seldom found in Great Britain." He figures examples from Cumberland and Lincolnshire, and mentions other specimens. The Doncaster example is different from any described by Sir J. Evans, but approaches nearest to that from Lincolnshire.

IN the *Museums Journal* (vol. xviii., No. 2, August, 1918) Mr. Harlan I. Smith, archæologist, Geological Survey, Canada, in a paper entitled "Archæological Museum Work and the War," remarks that the war has cut off from many firms in Canada and the United States the supplies of new designs in many industries, such as the textile trades, which were supplied by foreigners. To meet the sudden stoppage of the design supply, the writer has prepared an album of archæological specimens found in Canada suitable as motives for distinctive Canadian decorative and symbolic designs and trade-marks. In the same way in America designers have been developing designs from aboriginal objects in the United States museums, specimens from Peru, Mexico, the South-Western States, Siberia, China, etc. Though the colour combinations in silks woven from some of the designs developed from New World specimens are poorer than aboriginal colour combinations, yet these silks met with a ready sale, thus proving that aboriginal designs are not, as some have believed, crude, but can be successfully used in modern industries.

THE July issue of *Science Progress* contains an interesting article by Sir Henry Thompson on the food requirements of a normal working-class family. A comparison is instituted between the physiological values of the diets reported upon by the Board of Trade in pre-war times and some data collected by the War Emergency Committee in 1917. In reducing the family diets to man-values Sir Henry Thompson has employed a more liberal scale of requirements for children than the older standard of Atwater, which is now generally recognised to be unsatisfactory. The three diets do not differ greatly in respect of energy-value; the highest average is that of the urban working-class families (1913), yielding 3410 calories; the lowest, the 1917 sample, is 3160 calories, a reduction of but 250 calories. Sir Henry also provides ration scales based upon his estimate of the food consumption of Great Britain in 1908, upon that of the Royal Society's Food Committee for 1909–13, and upon the committee's estimate for the war-year 1916. Making allowance for loss in distribution, the calorie values of the diet scales calculated in this way do not differ very much from the observed values in the samples, although, as might be expected, the proportion of energy derived from breadstuffs is rather larger among the working-class families which provided the sample budgets than in the country as a whole.

A BRIEF, but very admirable, summary of the factors causing "grouse disease" on Scottish moors appears in *British Birds* for August. The author, Mr. Dugald Macintyre, surveying the conditions of heather-moors and their relation to "heather-blight," is of opinion that when, in exceptional years, heather suffers from frost in June, drought in July, and an excess of wet weather and too little sunshine during the early spring months—a combination of adverse conditions aggravated by the ravages of the heather-beetle—grouse disease is inevitable, and for the reason that the birds succumb to the drain on their vitality caused by their internal parasites, which in normal years of plenty cause them little or no discomfort. A practical remedy for grouse disease, he suggests, would be artificial feeding in those years when the heather crop fails. This he tried with a fair measure of success in 1912. The food supplied to the birds, after they had been trained to visit oat-sheaves laid out on the moors, was small, round maize, which the birds ate greedily. The ravages of the disease, he considers, are to be attributed largely to the fact that the birds are now artificially numerous; that is to say, the moors are carrying more birds than would be the case if they were left to "run wild."

So little is known generally of the vast and varied flora of South Africa that the short sketch of "The Plant Geography of South Africa," written by Mr. I. B. Pole Evans, chief of the division of botany and plant pathology in the Department of Agriculture, is very welcome. The sketch was printed in the official "Year Book" for last year, and has now been reprinted as a separate pamphlet. The vegetation is considered under the three main heads of woodland, grassland, and desert. All three types are well represented in the Union of South Africa, which includes almost all the area lying south of latitude 22° from the valley of the great Limpopo River and the Tropic of Capricorn to the sea. The article is accompanied by a good vegetation chart marking the forest and scrub area in the south and south-west, the palm belt along the Natal and Mozambique coast, with the thorn-veld extending from the south coast from Port Elizabeth to East London, and then to the west of the palm belt as far as the Transvaal. Basutoland and the Orange Free State Colony are almost entirely high veld, while the Transvaal is marked as bush veld, and the centre of the area is the Kalahari grassland. The Karroo and Namaqualand are, as is well known, extensive desert areas. Brief descriptions of the more prominent types of vegetation are given, and lists of the typical trees, grasses, and other plants, with particulars as to where such plants may be found. Not the least valuable portion of the article are the twenty-four excellent plates showing features like the natural Drakensberg forest, the silver trees on Lion's Head at the Cape, the acacia thorn veld, the Euphorbias of the bush veld in the Transvaal, and some very interesting photographs of the high veld grassland near Johannesburg and Pretoria. All the photographs have been taken by Mr. Pole Evans, and are very well reproduced. It is much to be hoped that a systematic botanical survey of the whole region may shortly be undertaken before any further changes in the vegetation due to the disturbing influence of man take place.

MUCH light is thrown on Balkan problems by a map compiled by Prof. Jovan Cvijic of the zones of civilisation in the Balkan peninsula. The map, which appears in the *Geographical Review* for June (vol. v., No. 6), is accompanied by a short article, and follows a map and paper by the same author in the previous number of the review on the distribution of Balkan races. Studied side by side, these maps are most instructive. In the present map Prof. Cvijic distinguishes three main civilisations: the old Balkan or modified Byzantine, distributed in Thrace, Macedonia, and Greece in the main; the Turko-Oriental, principally in the south-east, in the Vardar valley, and in parts of Bosnia; and, lastly, the patriarchal *régime* in the north and west of the peninsula. Attempts are also made to map the various contacts between these civilisations and those of Central and Western Europe. Western civilisations reached the Balkan peninsula chiefly by sea routes, and, according to Prof. Cvijic, nowhere, except along certain easy routes, penetrated far inland. From Trieste to Constantinople the seaboard shows Mediterranean influences. There are traces of Venetian civilisation in Serbia, but too few to be mapped. Magyar civilisation was a later influence, but it has spread widely and deeply along the main routes. Naturally, it is felt most in cities. Finally, Prof. Cvijic notes the tendency, especially in Serbia, to create a new endemic civilisation out of the mingling and fusion of other civilisations. The depth and power of spreading of that national civilisation will be a determining influence in the Balkans in future years.

A PAPER by the late Mr. R. C. Burton on "The Laterite of Leoni, Central Provinces" (Records Geol. Surv. India, vol. xlviii., p. 204, 1917), revives the frequently expressed view that some pisolitic laterites, at any rate, have accumulated by deposition as lacustrine strata. Grey bauxite is interbedded with laterite at Aturwani, and must have had a similar origin. Near Magarkatta, bright red lithomarge, passing into a brecciated condition, contains veins of kaolinite. Mr. Burton, who died from wounds received in the present war, was probably unable to examine the most recent literature on the interbasaltic rocks of Ireland, where similar associations have been recorded, and where pisolitic structure occurs within the bole that results from the decay of basaltic lavas by penetrating influences from above. He refers, however, to the views of Forbes and Mallet, who accepted a lacustrine origin, and to those of Lacroix (1913) as to the formation of concretionary pisolite *in situ*. Where, as the author believed to be the case in Leoni, the limits of the laterite coincide with those of a former lake, the pisolitic structure may well be a feature of original deposition.

KOREA is maintaining its claim to systematic registration of climatic conditions, as shown in the issue of the annual meteorological report for the year 1916, compiled under the direction of the Government-General of Chosen (Korea). Hourly observations made at Jinsen (Che-mul-po) are given for each month for air pressure, air temperature, relative humidity, direction and speed of wind, hours with sunshine by Jordan's recorder, and remarks showing the character of general and exceptional weather. Monthly and annual results at twelve stations well scattered over the peninsula from four-hourly observations are given for the elements already mentioned, as well as for tension of water vapour, precipitation, evaporation, direction of upper clouds, and surface temperature of earth. There are results of observations of air temperature and precipitation at 182 auxiliary meteorological stations, many of which are lighthouses, where observations are made three times daily. The volume also contains results of seismic observations at Jinsen. A map is given at the end of the report showing the geographical distribution of meteorological, climatological, and rain-gauge stations in Korea at the end of 1916. The whole of the peninsula is well covered by observations. In summarising the work done, mention is made of improvements in the routine work as the result of the decision of the congress of the directors of all the meteorological stations of the Japanese Empire held in Tokyo. The present volume shows an increase from nine to twelve in the number of branch meteorological stations. It is noteworthy that special attention is given to the selection of a suitable site in the matter of an observatory. Change has been made in the position of the building at Taikô. Improvements have been made in the issue of weather forecasts and storm warnings. Experience shows that a gale caused by a cyclone passing through the peninsula ceases generally within about twenty-four hours, so it has been determined that the effective interval of a warning is twenty-four hours from the time of issue.

AN interesting gravitational problem, with a bearing on the theory of coral reefs, has lately been studied by Motonori Matsuyama (Memoirs of the College of Science, Kyoto Imperial University, vol. iii., No. 2, February, 1918). Using an Eötvös gravity-variometer, he has determined the second derivatives of the gravitational potential (the complete set of these derivatives defines the space variations of the first derivative, *i.e.* of the gravitational acceleration or force, which was not measured and remains still unknown) in the Jaluit Atoll. This atoll (169° E., 6° N.) is situated at the southern end of the Ralick chain of the Marshall Islands. The shallow lagoon, of irregular rhombic shape (the diagonals being about 30 km. and 50 km. in length), is surrounded by a narrow coral reef about half a kilometre wide, with its top just at the level of low water. On this reef low banks of coral, sand, and *débris*, rising just above high water, form a chain of discontinuous islets. The island is situated in a sea which at ten kilometres distance from the atoll is four kilometres deep. The study of the gravitational field on an isolated island of very simple construction is calculated to throw light on the state of mass distribution under the atoll. The coral reef is built on a denser foundation, probably of volcanic origin, and the differences of density between the water, the reef, and the foundation are to some extent known. The problem which the gravitational data help to solve is that of the distribution and depth of the coral. After various instrumental and other corrections (for the effect of tides, the oblateness of the geoid, etc.) had been applied to the observed second derivatives of the potential, these were compared with the second derivatives theoretically calculated, on various assumptions as to the depth of the coral reef and the density of the foundation. For convenience in the numerical integrations employed, the foundation was supposed flat; three values were assumed for its density, viz. 2·6, 2·8, and 3·0. The "effective" depths determined for the coral reef ranged from 243 to 1000 metres.

E. ELÖD (*Elektrotechnische Zeitschrift*, March 21) has carried out experiments from which he concludes that during the formation of nitric oxide by the electric arc in the production of nitric acid from the air, the electric discharge causes the nitrogen and oxygen to split up into atoms, so as to be capable of producing chemical reactions.

THE use of black millet (*Sorghum vulgare*) for the production of alcohol has been suggested in Germany (*Zeitschrift für angewandte Chemie*, April 23), for which purpose it possesses suitable properties. The food-value of the grain is high, so that its cultivation, which costs no more than wheat or rye, is recommended to the farmer as being a paying crop. The use of the "straw" as a source of cellulose or alcohol would make the crop doubly valuable. According to recent French notices, the cultivation of sorghum for the production of sugar has been widely suggested.

ACCORDING to the *Zeitschrift für angewandte Chemie* for May 17, at a recent meeting of the German Bunsen Society the question of the production of synthetic rubber was discussed, and its possibilities as a substitute for the natural product considered. In spite of the difficulty of obtaining material, 150 metric tons of synthetic methyl rubber are produced monthly. At first the substitute proved unsatisfactory, being oxidised by the air, and it was hard to vulcanise. Improvements in manufacture have, however, overcome this trouble. By experimenting with the addition of other substitutes, a vulcanite is now produced which equals the natural material in firmness and durability, and is 20 per cent. better for electrical purposes. At ordinary temperatures, however, the soft rubber is not elastic, but leather-like; it becomes elastic as its temperature is raised. The addition of dimethylaniline and toluidine increases elasticity. The substitute is now used, with satisfactory results, for heavy road motors.

The Reichsanstalt at Charlottenburg has carried out an extensive series of tests on the effect of chemical changes and heat treatment on the magnetic properties of iron alloys. Tests were also made to ascertain the change of the temperature coefficient of bar-magnets with variations in their dimensions. Reducing the length of a 0·6 cm. thick bar from 22 to 2·4 cm. produced an increase of 2·4 to 4·2 per cent. in the mean temperature coefficient between 20° and 100° C. Tests were made with bars 0·9 cm. thick and of length varying between 33 cm. and 6 cm.; and it was found that the determination of the coercive force was trustworthy within 1 to 2 per cent. (using the magnetometer method) for cylindrical bars with values of l/d (l=length, d=diameter) down to 10, but that the value obtained for the coercive force was rather too small for lower values of l/d. These results are given in the *Zeitschrift für Instrumentenkunde* for May last, but the main results of the investigation will not be published until after the war.

Sulphurous acid liberated in the combustion of pyrites and other sulphurous substances contained in coal is rapidly transformed into sulphuric acid in the atmosphere. It is found in rain-water and snow. If the rain-water or snow is left for a few hours, the small quantities of non-oxidised sulphurous acid that they contain are rapidly converted into sulphuric acid. Thus the determination of the quantity of sulphuric acid in the snow or rain provides a means of determining the vitiation of the air in a particular industrial district by factory smoke. In one and the same industrial region from 6 to 9 mg. of sulphuric acid (or sulphuric anhydride) per cubic metre of snow was found in places protected from the wind, and three times that quantity in places not so protected. The mean was 15 to 20 mg. The quantity diminishes rapidly with increase in distance from the source of vitiation. According to the *Zeitschrift für angewandte Chemie* for April 9, similar data were found on experimenting with rain-water. It is also possible to determine the deleterious action on plant-life through the same cause by collecting, by suitable means, the rain collecting at a tree-trunk, and comparing the foliage, etc., with that of other trees in another neighbourhood (not near a factory) offering the same climatic conditions.

The June *Biochemical Journal* contains work on the antineuritic and antiscorbutic accessory substances by Messrs. A. Harden and S. S. Zilva. These authors find that pigeons are protected from attacks of polyneuritis by autolysed yeast, but not by autolysed yeast which has been shaken with fuller's earth or with dialysed iron, thus confirming Seidell's observation. Further, polyneuritis is curable by autolysed yeast, but not by autolysed yeast which has been treated with the adsorbent, and a bad case was cured by administration of the solution obtained by alcoholic extraction of the dialysed iron precipitate and evaporation *in vacuo*. On the other hand, when the precipitate obtained by shaking orange-juice with dialysed iron is extracted with alcohol, the product will not cure guinea-pigs of scurvy, nor will it protect healthy animals against attacks of the disease. But orange-juice which has been treated with dialysed iron or with fuller's earth retains practically all its antiscorbutic activity so far as can be judged biologically. A mixture of equal parts of orange-juice and autolysed yeast will both cure and protect from attacks of polyneuritis and scurvy. But after treatment with fuller's earth the mixture was found to have lost its antineuritic power whilst retaining its activity against scurvy. Thus it is shown that the antineuritic and antiscorbutic principles behave differently towards adsorbents. Orange-juice can be filtered through a Berkefeld filter without losing an appreciable amount of its antiscorbutic activity.

In order to supply material for testing the theories of thermal and electrical conductivities in metals and alloys, and especially in ferro-magnetic substances, Prof. K. Honda, of Sendai University, has measured the thermal and electrical conductivities of a number of nickel-steels. His results are given in the July issue of the Science Reports of the University. He finds that both the electrical and thermal conductivities decrease rapidly as iron is added to nickel or nickel to iron, and that an alloy containing 30 per cent. of nickel has the least conductivity in both cases. The curves showing the variation of the conductivities with content have the same general appearance as the melting-point curves for a binary mixture. The least electrical conductivity is about one-fifth and the least thermal about one-tenth the conductivity of either pure substance. The quotient of the thermal by the electrical conductivity varies from about 2 to about 1·5 millions. The magnetisation curves for the alloys are also given, and show low susceptibilities for alloys containing 27 to 30 per cent. of nickel.

Rapid inter-Imperial communication of every description now promises to become so vital a matter for developing inter-Imperial trade—as well as for other eminently important national reasons—that Mr. Charles Bright has prepared a revised edition of the map included in his recent book, "Telegraphy, Aeronautics, and War," showing not only the world's cable system, but also (1) both past and prospective "wireless" stations, (2) suggested air stations. The map will be issued shortly by the publishers of the volume, Messrs. Constable and Co.

The *University of London Press, Ltd.*, is about to issue "Everyman's Chemistry: The Chemist's Point of View, and his Recent Work told for the Layman," by E. Hendrick. The *Yale University Press* (and, in London, *Mr. Humphrey Milford*) will publish shortly "Human Nature and its Re-making," by Prof. W. E. Hocking.

OUR ASTRONOMICAL COLUMN.

Variable Stars.—As many of the ephemerides of these stars that were formerly available are discontinued or inaccessible owing to the war, M. Luizet has prepared a useful set of ephemerides for 1917, which is published in the *Journal des Observateurs* (vol. ii., No. 8). It comprises 124 stars of the Algol type, 18 stars of the β Lyræ type, and 33 stars of the δ Cephei type; the period and date of first minimum (or maximum) in each month of 1917 are given, and other data, which make it easy to calculate intermediate minima or to extend the ephemerides to 1918 or later. The lists are practically confined to stars visible in European latitudes.

THE ORIGIN OF COMETS.—In an article which appears in the August issue of *Scientia* (vol. xxiv., p. 85), Prof. E. Strömgren gives an interesting account of the reasons for regarding comets as permanent members of the solar system. In recent years exact calculations have shown that comets which have appeared to traverse hyperbolic orbits, when in the neighbourhood of the sun, acquired the hyperbolic form in consequence of the perturbations to which they were subjected by the planets. It is accordingly concluded that comets belong to our system, and that the so-called non-periodic comets are merely comets which have very long periods. The possibility of a comet entering our system from without is not excluded, but it is stated that no case of this kind is yet known. By reference to the dynamics of star-clusters it is argued that, while remnants of nebulous matter would, in general, be retained within the systems formed by individual suns, those which originally occupied the intermediate spaces would escape from the galactic system on account of the high velocities corresponding with their small masses. On this view, comet-forming materials would not exist in interstellar space.

SOLAR PHYSICS OBSERVATORY REPORT.—The fifth annual report of the director of the Solar Physics Observatory, Cambridge, relating to the year ending March 31 last has been received. A study has been made of the South Kensington series of photographs of the spectrum of β Lyræ, and information has been gained as to the best epochs for further records with comparison spectra. Further investigations of the hydrocarbon-band lines in stellar spectra have indicated a sequence in which there is a gradual strengthening of the hydrocarbon lines from type F to type G, and a gradual weakening of the same lines from the G to the M type. Photographs of the sun's disc in calcium light were obtained on 161 days, and of prominences at the limb on 153 days; the disc spectroheliograms provide records for fourteen days which were missed in the Kodaikanal series. Numerous photographs of sunspot spectra were also obtained, and a comprehensive table of the affected lines recorded by various observers has been prepared. The necessity for a daily reference photograph of the sun's disc has led to the utilisation for this purpose of the image-lens of 60 ft. focal length which forms part of the McClean solar installation; by the use of slow bromide paper the photographs obtained have proved to be of greater value than was anticipated, inasmuch as they present the faculæ as well near the centre of the disc as near the limb. These photographs seem likely to be of special value in the elucidation of the relation between faculæ and flocculi. Investigations connected with the national defence have also been undertaken.

BRITISH SCIENTIFIC INSTRUMENTS AND PRODUCTS.

OF the lectures delivered at the British Scientific Products Exhibition, organised by the British Science Guild at King's College, a feature common to all is the disclosure of the backward state of the industries with which they were respectively concerned when the war broke out. In radiology the outbreak of war four years ago found a condition of unpreparedness in common with other branches of medicine. It was necessary to provide large quantities of new apparatus and the adequate staff for many new departments. This state of affairs was described by Dr. R. Knox in the course of a lecture on the practical uses of radiography; and the backward state of the industry which he described as prevailing four years ago is all the more remarkable when we remember that although the X-rays were discovered by Prof. Röntgen, the discovery, as Mr. A. A. Campbell Swinton, who presided at the lecture, pointed out, could never have been made but for previous scientific research carried out in England. Had it not been for the work of Faraday, the necessary high-tension electric currents would not have been available, while the Crookes high-vacuum tube with which the rays were produced was the result of the laborious and long-continued investigations of that veteran scientific explorer, Sir William Crookes, who, although eighty-six years of age, is still young enough to be an exhibitor at the exhibition. Mr. Campbell Swinton also pointed out that the two greatest advances made in connection with X-rays since their original discovery were due in large measure to professors at King's College, the original Crookes "focus" tube having been adapted to X-ray purposes by Sir Herbert Jackson, and the recently invented Coolidge tube, though brought out in the United States of America, was based on the experimental results obtained by Prof. O. W. Richardson, also of King's College, working on lines laid down by Sir J. J. Thomson, of Cambridge.

Though the industry associated with radiography is small, its importance is great and promises to become greater in the future. Dr. Knox stated that experience gained in the administration of X-ray departments on a large scale, such as had been possible during the past four years, had taught us the necessity for a standardisation of apparatus. Had this been achieved before the outbreak of war, as he considers it well might have been, the task of rapidly equipping numerous departments would have been easy and the standard of work done much more satisfactory than it has been under the conditions possible in war time. The lecturer emphasised the need for research in connection with the production of essential apparatus and X-ray tubes if we were to hold our own in competition after the war. Most important research work has been carried out in this country lately in connection with the accessory apparatus, and Dr. Knox stated that the intensifying and fluorescent screens at present in use are an advance on those we formerly imported from Germany. The manufacturers of X-ray plates have more than held their own, and the production of a trustworthy photographic paper upon which X-ray negatives may be produced directly is one of the achievements of the war period. The most striking of the recent applications of X-rays and radium described by Dr. Knox is that used by Mr. Percival P. Cole in connection with his operative work on injury to the face and jaws. Another new development in plastic surgery is also associated with Mr. Cole's name, the well-known depilatory power of X-rays having been used for the destruction of hair in portions of the scalp and face which are used in plastic surgery. Dr. Knox insisted more than once in the course of his lecture on the need for encouraging research and bringing about the co-operation of all interested in the work. He said that steps are in progress with the view of forming a British school of radiology and physicotherapy.

In describing advances in bacteriology during the war, Dr. C. H. Browning, director of the Bland-Sutton Institute of Pathology of the Middlesex Hospital, mentioned that the need to overcome the poison of sepsis in wounds had stimulated profitable investigations on the properties of flavine and other dye-stuffs as antiseptics. He emphasised the relation between biology and chemistry and physics, and said that the chemical manufacturers could be of special help by assisting in the production of new drugs, under the guidance of the observations of biologists. In this line Germany had been especially active in the past. The microscope furnishes another example of the German development of English ideas. At present the industry for all practical purposes has almost ceased to exist, but Mr. J. E. Barnard claimed that it was undergoing a process of transformation which at the close of the war would make the British microscope pre-eminent. Between 1880 and 1890 this country stood foremost in the microscope industry, but after that time it lost its position to Germany because the latter gave us an instrument which was much needed at that time, being simpler in design and easier to construct. The Germans turned out a type known as the "Continental Model" which was useful for laboratory purposes. There was an insufficient supply of the English instrument, and this fact, coupled with the high price of the British article, enabled the Germans to obtain pre-eminence in this field. Unfortunately, it became the fashion to use the German instrument; and although the English instrument was equally good, home makers had little chance owing to the orders passing to the Continent. As in the case of the British dye industry, the English microscope industry was in British hands, but was lost for preventable reasons.

This is practically the same tale as Dr. M. O. Forster had to tell with regard to British dye-making in the course of his lecture on August 26. Dr. Forster traced the decay of the British industry after 1870, up to which time the principal competitors were the French manufacturers, but after the Franco-German War the German factories rapidly took the lead, and the period 1870 to 1880 must be recognised as that in which British dye-making was definitely overtaken by the German industry. The causes of this change are easy to recognise. The liberal Government subsidy to the German universities, wisely paid out of the enormous indemnity wrung from the defeated French nation, resulted in producing a rapidly increasing army of well-trained and enthusiastic young German chemists, who were quickly absorbed by the chemical factories. These were strengthened also by several older chemists, who, discouraged by the outlook for chemistry in this country, left the colour factories in which they had been working and returned to their own country in search of more agreeable conditions. Moreover, Prof. Hofmann had already left this country in 1865, and, occupying the professorship of chemistry in Berlin University, was largely instrumental in building up the German school of organic chemistry. Dr. Forster said that ten to fifteen years would be required before this country would be able to equal the position of Germany in regard to dye-making, and then only if the same principle of patient inquiry into scientific principles, liberal expenditure on chemistry and chemists, thoughtful attention to the requirements of customers, strict self-control in the distribution of profits, and constant devotion of these to further developments were observed. The establishment of synthetic indigo manufacture on a commercial basis was the outcome of close and systematic study by a large number of German chemists, who were subsidised by a company sufficiently courageous to spend money in this manner rather than distribute it as dividends to shareholders. It is only by following these same processes of development that we can earn the right to take credit to our countrymen for the aniline colour industry.

HIGH-TENSION MAGNETOS.

THE British Scientific Products Exhibition at King's College, London, organised by the British Science Guild, provides many encouraging examples of the success of British engineers in applying the results of scientific research. Many visitors interested in applications of electrical science are impressed by the range of magnetos exhibited, not only because it represents the successful establishment in Great Britain of an industry which was formerly a German monopoly, but also because the development of that industry has accelerated progress in numerous branches of scientific industry. It is no exaggeration to say that the degree of success achieved in the development of the combustion motor has at all stages been primarily dependent upon the efficiency of the ignition system used, and that the rapid strides which have during recent years been made in the construction of the petrol motor have mainly resulted from the very satisfactory high-tension ignition system that has been available.

During the past twenty years we have witnessed the birth and healthy development of high-tension ignition in the form of the magneto, and the wonderful efficiency of this system, coupled with its extreme flexibility—enabling one magneto to cope with almost any number of cylinders—is primarily responsible for the enormous advances which have taken place in the application of the petrol motor to industrial and, in more recent times, to war purposes Prior to the outbreak of war the number of high-tension magnetos being produced in this country formed a negligible proportion of the total number used for a variety of purposes. Through laxity on our part, this most vital "key" industry was allowed to develop in Germany, but it is satisfactory to know that the war has taught us a lesson in this respect, and the exhibition demonstrates how effectively this lesson has been learned. During the past four years three hundred thousand magnetos have been manufactured for war service alone, and what is even more important is that, according to those in a position to judge, the British magneto, as at present constructed, is more than equal to the pre-war Bosch magneto emanating from Stuttgart. This is sufficient testimony that British manufacturers have done their duty.

All electrical systems of ignition are direct descendants of Faraday's great discovery of electro-magnetic induction in 1831, when for the first time in the world's history he succeeded in producing a spark by electro-magnetic means. The first system of electric ignition ever used was devised by Lenoir in 1860. He utilised the high-tension spark of a Ruhmkorff coil for ignition purposes, employing a high-tension distributor for connecting the secondary winding, first to one plug and then to the other. It is worth noting that the modern battery system of ignition now used extensively in America is strikingly similar to the old Lenoir system, even to the detail of introducing an extremely small air gap between the rotating metal brush and the distributor segment—a method of distribution that is now being followed on magnetos. Marcus appears to have been the first man to construct a magneto for ignition purposes. His was a low-tension machine having the now familiar form of H-armature, the current induced in the winding being broken at pre-determined times in the cylinder by a system of cams and levers. This system was further developed in 1898 by Simms and Bosch, using a fixed H-armature and rotating segments for producing the necessary flux changes in the armature core. This is of special interest because afterwards, by the addition of the second winding on the same armature core, a high-tension magneto was evolved.

To the Bosch Company, of Stuttgart, belongs the credit of having established the fact that a high-tension magneto can be manufactured on a commercial basis to give trustworthy and efficient ignition in practice. Although this important industry was allowed to develop in Germany, the modern high-tension magneto was first conceived in France by M. Boudeville, who, unfortunately, omitted to include a condenser in his scheme for eliminating sparking at the contact points. A condenser is a vital part of every magneto; without it the machine would be quite impracticable. It is surprising that M. Boudeville should have overlooked this feature, because, here again, the idea of using a condenser for such a purpose is of French origin, Fizeau being the first to suggest, in 1853, connecting a condenser in parallel with the contacts on a Ruhmkorff coil to prevent excessive sparking.

The magnetos made in this country vary somewhat in design, being based to some extent on the original Bosch model with improvements in many respects. Thus the trouble which was experienced with the original Bosch D.A.L. design of misfiring has been completely removed in a machine of the rigid armature single-cylinder type intended for use on rotary engines like the Gnome. The Bosch Z.U.4 machine was formerly extensively used in this country. The design of this has been considerably simplified, chiefly in respect of construction of the bearing for the half-speed wheel. An 8-cylinder sleeve-inductor magneto with fixed armature, now made in this country, is designed to give four sparks per revolution, and is therefore fundamentally different from the ordinary rotating armature type, which cannot give more than two sparks per revolution. The sleeve-inductor rotates at engine speed, whereas, in the case of a 6-cylinder machine built on the same principle, it runs at three-quarters engine speed.

In a single machine of the 8-cylinder type there are 860 parts, no fewer than 397 of which are of different design. The manufacture is therefore attended with considerable difficulties, and can be undertaken successfully only if highly skilled labour is available and the component parts are all machined to extremely fine limits. The fact that these magnetos are being produced in very large quantities is evidence that the difficulties are being overcome. A magneto of the polar induction type, also developed in this country, is intended more especially for 12-cylinder work. This is probably the first 12-cylinder model developed and standardised in this country. The machine is inherently of much simpler design than the sleeve-inductor machine, because the latter, which on account of its design is very difficult to manufacture, is replaced by a polar inductor which is designed to be easily made, and is at the same time a more rigid and trustworthy mechanical structure. Other features combine to simplify the manufacturing problem greatly.

No matter for what purpose a magneto is to be used, the chief feature must be trustworthiness, and this is possible only if the design is good, the materials are correctly chosen, and the workmanship is perfectly sound. Of the first- and last-mentioned conditions there can be no question. With regard to the choice of materials, the development of both the metallic and non-metallic industries has left it beyond doubt that such materials will be available. The improvement in foundry methods has resulted in the regular supply of trustworthy aluminium castings; in steels important advances have been made, which now give the required strength with a minimum weight of material. Die-castings made of an aluminium alloy containing no zinc are a great advantage. The manufacture of die-castings was formerly neglected here, but British producers are now devoting their attention to the subject, with the result that there is available an adequate supply of these castings. The advantage of die-castings over sand-castings is that the amount of machining that has to be performed on the parts is very much reduced, the metal is much tougher, and the threads in tapped holes are not so likely to become stripped when the screws are securely tightened. With regard to non-metallic materials, the most important requirements are insulating materials, comprising varnished silk, cambric, and paper. These insulating materials are essential to the manufacture of a satisfactory magneto armature, and although they can be purchased in England at the present moment, a fair portion is still imported. It is probably correct to say that the small extent of the magneto industry contributed in a large measure to the backward state of the insulating material industry in this country, in regard not only to paper, silk, and cambric, but also to moulded insulating material comparable with "stabilite," a German product. Now, however, this industry is becoming firmly established. Here, again, we have an impressive example of the effect of one industry upon another. The magneto industry itself is of sufficient importance and magnitude to be regarded as a "key" industry. With its development there has been established a number of new industries concerned with the supply of component parts. The manufacture of insulating materials, varnish, platinum-iridium or tungsten contacts, aluminium-copper die-castings, special steels—these industries either did not exist at all in England, or else were of only small dimensions. Each of them has now become an important British industry, largely in consequence of the home production of magnetos. Even if the British Science Guild had done no more, its achievement in pressing home this fact through the medium of the exhibition at King's College would entitle the Guild to the thanks of the nation.

ELECTRON.

WEATHER INFLUENCES ON OPERATIONS OF WAR.

AN article on "Weather Controls over the Fighting during the Spring of 1918," by Prof. Robert deC. Ward, appeared in the *Scientific Monthly* for July. Such vast interests are at stake in the present war that any factor which can help or hinder is of immense importance. The part played by meteorological controls is set out by the author as fully as is possible at the present time, leaving fuller information for a later date.

In the Western war zone the season of aggressive operations has generally been from April to November. The offensive on the part of the enemy began this year on March 21, and the author states that "the time must have been carefully chosen after consultation with the meteorological experts. It was a spell of fine, dry weather." Easterly winds usually accompany such spells, and these are "favourable for the use of gas by the enemy and also carry the smoke of artillery firing to the west, thus helping to screen the attacking troops." A thick fog also favoured the attack, and "the Allied gunners could scarcely see their own horses"; the author mentions that "the surprise of the British Fifth Army was largely attributed to the fog." In the opinion of the present writer, no meteorologist could have foreseen with any reasonable certainty such favourable weather conditions. A change to less settled weather occurred at the end of the month, and it proved very favourable to the Allies, whilst "the Germans were at once greatly handicapped because of the difficulty of moving their troops, artillery, and supplies through the deep and sticky mud."

Advantage was again taken by the enemy of fog during a dry spell in the second week of April, but the general weather conditions throughout the month were unsettled and not favourable for aggressive work, whilst similarly unfavourable weather prevailed during the greater part of May.

The German offensive was renewed on May 27. A high and steady barometer with light easterly winds prevailed with morning fogs, and similar weather was experienced through the first week of June, whilst in the after part of the month short spells of similar weather occurred

The controlling influence of the weather on the Western front during the summer push commenced by the Allies about the middle of July and continued for so many weeks with such marked success should tell in favour of the Allied meteorologists. The move was undertaken when an exceptionally wet period was drawing to a close, and the lengthy spell of fine and dry weather, with a succession of calms and light winds and a steady barometer with not too high a temperature, has proved a most favourable weather control. This aggressive move is beyond the period of Prof. Ward's article.

Some interesting occurrences are given in connection with the use of gas; two instances, April 10 and May 12, are cited of a sudden shift of wind blowing the gas back in the face of the enemy. The Daily Weather Charts, published by the Meteorological Office, support the change of wind.

The most favourable season for submarine activity is referred to; the smoother water and the longer daylight of summer are mentioned as an advantage in that season, but as an offset in winter there are the longer nights "to come to the surface to re-charge their batteries, to rest their crews, and to make long trips unsubmerged, thereby increasing their effective area."

A despatch from Rome, dated May 20, mentioned that "the only obstacle which prevents an enemy attack is the weather . . . but the weather is becoming undeniably milder, and the snow is beginning to melt. . . ." The author reminds us that "during the last days of May the Italians won a brilliant victory in the Tonale region, some 12,000 ft. above sea-level, whilst the ground was still covered with snow."

In Palestine a sandstorm on March 16 is referred to as a weather control, under the cover of which "a company of the Turkish Camel Corps was surprised and destroyed."

The author states that in the daring raid on the German naval bases at Zeebrugge and Ostend (April 22) "certain conditions of wind and weather" were waited for, whilst "the losses of the Zeebrugge raiders were due almost entirely to a shift of the wind, which prevented the complete success of the smoke screen."

The prevailing westerly winds occasion much difficulty to our airmen at the front, and an aviator has said: "If an airman ever wishes for a favourable wind, it is when he is breaking for home." Whatever aircraft can do, it is noteworthy that no air raid has as yet occurred in London with an overcast sky.

C. H.

MAGMATIC SULPHIDE DEPOSITS.

PROFS. C. F. TOLMAN AND A. F. ROGERS, of the Leland Stanford University, California, have issued a small volume in the University Series of Publications entitled "A Study of the Magmatic Sulfid Ores." They restrict the term "magmatic ores" somewhat more narrowly than most other writers on the subject have done, and consider that such ores are not the product of segregation properly so called. The ores studied by them are associated with basic igneous rocks, such as norite, gabbro, peridotite, etc., these rocks occurring generally as small dykes or sills, and comparatively rarely as large laccoliths. The ore is generally segregated at the margins of the intrusives, but occasionally occurs as a lenticular mass well within the magma, and never migrates more than a few feet into the adjoining rocks. Apart from the magnetite-ilmenite group, which is excluded from the present discussion, magmatic ores are divided into two classes, (*a*) pyrrhotite-chalcopyrite and (*b*) chalcopyrite-bornite; pyrites is not a typical magmatic mineral. The metallic minerals are formed at a late magmatic stage by a partial replacement of silicate minerals, and there is also evidence of the replacement of one magmatic metallic mineral by another. Hydrothermal alteration is relatively insignificant, and is distinctly later than the magmatic-ore period. The following is the series of events recognised by the authors as leading to the formation of magmatic ore deposits:—(*a*) Crystallisation of primary silicates; (*b*) development of hornblende and biotite, and occasionally tourmaline and garnet, as magmatic alteration products; (*c*) introduction of ore-minerals; (*d*) re-arrangement of ores and development of secondary silicates by hydrothermal solutions. The temperature at which the introduction of the metallic minerals commences probably does not exceed 300° to 400° C. It will be noticed that the authors ascribe the formation of these magmatic sulphide deposits to causes very different from those generally accepted.

THE PROPOSED UNIVERSITY OF THE EAST MIDLANDS.

THE movement for establishing a University of the East Midlands took its start some dozen years ago in the growth of the University College, Nottingham, and steps towards obtaining a charter were already being taken before the war. The war seemed at first to stand in the way of further action, but the needs which it brought to light, and the readiness to co-operate which has been displayed throughout the East Midland province, have extended the plans of the supporters of the movement. The proposed University will, indeed, have its foundation in the University College, Nottingham, but it is anticipated that the neighbouring cities and counties will enter upon a federal relation through the development of their existing educational institutions and the establishment of new. For example, the Agricultural College which is jointly maintained by the county councils of the East Midlands at Kingston, near Loughborough, is marked out for the agricultural faculty. Further, the close proximity of Leicester, Derby, and Nottingham will make it easy for the services of professors and lecturers in the University to be shared by these three centres.

The Corporation of the City of Nottingham, which founded the University College in 1881, has declared its readiness to hand over the present site and buildings, representing a value of some 200,000*l.*, and to make a permanent annual grant of 15,000*l.* when the University charter is granted. The Nottinghamshire County Council has, under similar conditions, promised an annual grant of 5000*l.* The neighbouring authorities are taking up a friendly attitude to the scheme, and have under consideration the form and amount of the assistance to be given. The Mayor of Nottingham has undertaken to raise an endowment fund of 150,000*l.*

The new University, it is expected, will not only further the application of science to industry throughout the locality, but will also embody the very spirit of humanism by working in close touch with the artisan classes, and especially with the Workers' Educational Association.

THE ROMANCE OF PETROLEUM.[1]

PETROLEUM is defined in the Petroleum Act of 1871 as including "any rock oil, Rangoon oil, Burmah oil, oil made from petroleum, coal, schist, shale, peat, or other bituminous substances, and any products of petroleum, or any of the above-mentioned oils."

The scientific definition is even wider, embracing natural gas, solid bitumen, and ozokerite.

It is, therefore, an appropriate introduction, for the suggestion of which I am indebted to the Fullerian professor of chemistry, to recall that it was in the laboratory of this institution, in 1825, that Faraday examined the liquid which separates when the gas made by the destructive distillation of fixed oils is subjected to compression, and isolated from it the hydrocarbon benzene, as well as several other compounds of carbon and hydrogen.

In 1815 John Taylor was granted a patent for a process described as producing "inflammable air or olefiant gas applicable to the purposes of giving light" from vegetable or animal oil, fat, bitumen, or resin. This oil-gas, compressed by a method patented by Gordon and Heard in 1819, was supplied by a company having the title of the London Portable Gas Company. It was contained in vessels having a capacity of 2 cubic ft., which were delivered to the premises of consumers, and returned when empty to be refilled. The liquid which separated when the gas was compressed into these cylinders was that which Faraday examined.

It is not reasonable to assume that whilst he was ascertaining the chemical constitution and properties of what was actually synthetic petroleum, Faraday can have realised the importance of the part destined to be played by these hydrocarbons in peace and in war.

Nevertheless, his extended reference to what he describes as the remarkable action of sulphuric acid upon the compounds of carbon and hydrogen which he had isolated, and his subsequent paper on the mutual action of sulphuric acid and naphthalene, appear to indicate that he may have had an intuitive perception of the valuable industrial developments in the manufacture of dyes which after many years followed his classic researches.

In the same year Faraday also published the results of his examination of caoutchouc, and showed that this substance is mainly a compound of carbon and hydrogen.

Eleven years later Edmund Davy, a cousin of Sir Humphry Davy, discovered the gaseous hydrocarbon which we now know as acetylene. The account of his discovery which he gave at the meeting of the British Association in 1836 was as follows:—"Early in the present year the author, in attempting to procure potassium by strongly heating a mixture of calcined tartar and charcoal in a large iron bottle, obtained a black substance which readily decomposed water and yielded a gas which, on examination, proved to be a new compound of carbon and hydrogen."

It is interesting to note the relation between these respective researches of Faraday and Edmund Davy and the rival theories of the organic and inorganic origin of petroleum, to which further reference will be made.

There are many obvious allusions to the occurrence and uses of petroleum in the Old Testament scriptures. Thus in the account of the building of the Tower of Babel we are told that "slime had they for mortar," the word "slime" in our version being given as "bitumen" in the Vulgate. Again, in Genesis xiv. 10, the vale of Siddim is described as "full of slime pits," and on this account it has been suggested that the destruction of Sodom and Gomorrah may have occurred through the sudden outburst of petroleum in this region. This has led Mr. W. H. Dalton to remark that the destruction of these cities and our recent conquests in Palestine were effected by the same agency, with the essential difference that in the latter case the flow of the oil was under control.

The vale of Siddim, with its slime pits, is no more; even its precise position is a matter of doubt, but the pitch spring of the Ionian island of Zante, described by Herodotus in 450 B.C., may still be seen.

The photograph of this spring of petroleum now projected on the screen was taken in 1890, whilst my guide was in the act of inserting an olive branch into the spring and withdrawing it dripping with the oil, the flow being, apparently, as abundant as it was more than two thousand three hundred years previously. I may add that drilling for petroleum in the locality has not resulted in obtaining any yield of commercial importance.

Long before the Christian era the drilling of wells for natural gas, with a view to its use as a source of heat in evaporating brine, was a recognised industry in China, and it is worthy of note that the instruments employed bear a close resemblance to modern drilling appliances.

Petroleum occurs in greater or less quantity throughout the whole range of strata of the earth's crust, from the Laurentian rocks to the most recent members of the Quaternary period, but it is found in quantities of industrial importance almost wholly in the comparatively old Devonian and Carboniferous formations on one hand, or in the various divisions of the comparatively young Tertiary rocks on the other.

Its origin has been the subject of much controversy among distinguished geologists and chemists who have devoted special study to the subject. Berthelot and Mendeléeff lent the weight of their authority to the theory that petroleum was derived from metallic carbides lying far beneath the porous strata in which the oil is stored, and made the attractive suggestion that the process might be conceivably in operation at the present time. The view is now, however, universally accepted that petroleum is of organic origin, and that it has been produced from vegetable matter and the lower forms of animal life, chiefly aggregated during the geological periods referred to, when favourable conditions, which did not persist through the whole period, occurred. In certain places—for instance, in Karabugas Bay, on the eastern side of the Caspian Sea, in Sweden, in Sardinia, and in the eastern part of the Mediterranean—there is some conversion of organic matter into petroleum actually to be seen in progress at the present time.

Whilst, however, as I have said, there is general agreement as to the organic origin of petroleum, there is considerable difference of opinion as to whether the oil is in all cases indigenous to the strata in which it is found, and as to whether the conversion of the organic matter was practically completed when the strata were formed, so that the age of the rocks is that of the petroleum found therein. There are distinguished advocates of the view that petroleum results from the action of a slow, continuous process of dis-

[1] Abridged from a discourse delivered at the Royal Institution on Friday, June 7, by Sir Boverton Redwood, Bart.

tillation of the material yielding it, accompanied by a transference of the product to strata lying above those in which its formation originated. According to some, this process occurred at a definite and distant time in the past, long subsequent to the formation of the petroliferous strata; but in the opinion of others it may be in progress at the present time. The question is not one of academic interest only, for it obviously would be of vast importance if it could be demonstrated that our stores of petroleum, which are being depleted with alarming rapidity, might be replenished. I fear, however, that there is no ground for such an encouraging anticipation. As Lesley, the United States geologist, remarked in 1886:—"I am no geologist if it be true that the manufacture of oil in the laboratory of Nature is still going on at the hundredth or the thousandth part of the rate of its exhaustion. And the science of geology may as well be abandoned as a guide if events prove that such a production of oil in western Pennsylvania as our statistics exhibit can continue for successive generations. It cannot be. There is a limited amount. Our children will merely, and with difficulty, drain the dregs."

Probably each of the views expressed in relation to the organic origin of petroleum has some elements of truth in it, and it is reasonable to assume that a substance so varied in chemical and physical characters has not in all cases been created under precisely the same conditions or from an exactly similar source. On the whole, however, the balance of evidence appears to point to the conclusion that the petroleum which we now find in the Palæozoic and Tertiary rocks is of substantially the same geological age as the rocks themselves. It is, I believe, uncertain whether man existed on the earth before the close of the Tertiary period, but there is abundant evidence of the existence of the human race in the following Quaternary period. The advent of man may, therefore, have been coeval with the completion of the petroliferous formations.

Not less important than the provision of adequate supplies of organic matter to be transformed into petroleum is that of a suitable rock-formation for its reception and conservation. For the latter we need a porous stratum, such as coarse-grained sandstone or conglomerate or dolomitised limestone, with an impervious cover, such as that provided by fine-grained shale. In addition, in order that the wells drilled may furnish individually a large yield of oil, it is essential that the petroliferous strata should have been caused to assume an anticlinal structure. Under these tectonic conditions any natural gas accompanying the oil accumulates at the crest of the anticline, whilst the oil occupies the flanks, and water is found in the synclines. The gas often occurs at a pressure of many hundred pounds on the square inch, and it is obvious that in these circumstances a well drilled into the flank of the anticline may produce an oil fountain.

The geographical distribution of petroleum is no less wide than the geological, but the deposits mainly occur along well-defined lines, often associated with the mountain ranges. This is chiefly due to the formation, in the elevatory process, of minor folds, which have arrested and collected the oil in richly productive belts, between more or less barren areas, in the manner already referred to.

There are, however, but few of the localities indicated as petroliferous which contribute largely to the world's output of petroleum, estimated for last year as approximately 70,403,128 metric tons.

The predominant contributor is the United States, which furnished no less than 64·74 per cent. of the estimated total for 1917, the others in order of importance being:—Russia, with 13·26 per cent.; Mexico, with 11·37 per cent.; the Dutch East Indies, with 2·74 per cent.; Rumania, with 2·08 per cent.; India (Burma and Assam), with 1·61 per cent.; Persia, with 1·32 per cent.; Galicia, with 0·947 per cent.; Japan, with 0·615 per cent.; Peru, with 0·511 per cent.; Trinidad, with 0·303 per cent.; Germany, with 0·189 per cent.; the Argentine, with 0·170 per cent.; Egypt, with 0·094 per cent.; Canada, with 0·037 per cent.; Italy, with 0·002 per cent.; and other countries, with 0·006 per cent.

It is not surprising that the flood of oil which has been poured out by the wells of the United States in ever-increasing volume since 1859 should now be attended by signs of the approaching exhaustion of the petroliferous territory, and it has been estimated by Dr. David T. Day that, at the present rate of increase of the output of petroleum, the known oil-fields of that country will, on the basis of the minimum quantity of oil obtainable, be exhausted by the year 1935.

The oil-producing countries of the British Empire are India (Burma and Assam), the West Indies (Trinidad), and Canada, and these in the aggregate furnish only 2 per cent. of the total given.

Under these conditions the British Government is to be congratulated on having secured the control of the exceptionally prolific oil-fields of Persia.

In the British Isles, as is well known, there is a flourishing industry in the mining and distillation of Scottish shales as a source of mineral oil and ammonia. This industry owes its existence to James Young, of Kelly. In 1847 Young's attention was directed by Playfair to a stream of oil flowing from the top of a coal-working at Alfreton, in Derbyshire. From this oil he succeeded in extracting, on a commercial scale, paraffin-wax, lubricating oil, and burning oil. The supply of the raw material being soon exhausted, Young attempted to imitate the natural processes by which he believed the oil to have been produced, by the action of gentle heat on coal, and in 1850 made his invention the subject of his celebrated patent for "obtaining paraffine oil, or an oil containing paraffine, and paraffine from bituminous coals by slow distillation." The process was extensively carried out in the United States, under licence from Young, until crude petroleum was produced in that country in such abundance, and at so low a cost, that the distillation of bituminous minerals became unprofitable.

In this connection it is interesting to note that, in consequence of the approaching exhaustion of the oil-fields of the United States, attention is now being actively given to the utilisation as a source of oil of the immense deposits of bituminous shales known to exist in that country.

I have mentioned the work carried out by Young on the crude petroleum of Alfreton, and this leads me to refer to the prospects of obtaining free oil in quantity in this country. For many years there was an actual output of petroleum recorded in the General Report and Statistics relating to Mines and Quarries in the United Kingdom, issued by the Home Office. The annual output reached its maximum in 1893, when it amounted to 200 tons, valued at 488*l.* It had fallen to five tons, valued at 12*l.*, in 1899, and was returned as nil in the following year. There was a recorded production of eight tons in 1901, and twenty-five tons in 1902, none in the two succeeding years, forty-six tons in 1905, and ten tons in 1906, the principal locality of production for the latter years being Dumbartonshire. Since 1906 no output has been recorded.

Apart from the production referred to, there have been discoveries of oil in this country from time to time, some of which were of a very doubtful character. An interesting occurrence of free petroleum was brought to my notice in 1892. It took the form of a sudden influx of some hundreds of gallons of light-coloured oil into a well which was the source of the water supply of an isolated dwelling-house standing on high ground near Shepton Mallet. Another case, which is certainly genuine, is that of the oil find in a test-boring made for coal at Kelham, near Newark. From this bore-hole, which at a depth of between 2400 ft. and 2500 ft. had penetrated a bed of porous sandstone, a flow of characteristic crude petroleum amounting to five or six gallons a day took place. The much-advertised discovery at Ramsey, near Huntingdon, cannot be included in the same category, for the oil had unquestionably leaked from an adjacent store.

It may confidently be asserted that in certain parts of Great Britain the geological conditions are consistent with the existence of valuable stores of petroleum, but doubt has been expressed as to whether the drilling operations which the Government has decided to undertake will be attended with success. It is, however, admitted that the only conclusive test is that of the drill. Some months ago Lord Cowdray publicly announced his belief that oil may be found in commercial quantities in Great Britain, and stated that his firm was prepared to spend 500,000*l*. on exploration and development if certain areas were reserved to them.

Even if we should be unsuccessful in finding free oil, we know that we have abundant stores of bituminous minerals from which oil can be obtained by destructive distillation.

For centuries petroleum has been raised from hand-dug wells in Burma, Rumania, and Galicia. In the days when King Thebaw reigned in Burma the winning of petroleum by hand-digging in the Yenangyaung district was an important source of revenue.

This primitive system of production has been superseded by the introduction of modern methods of drilling, in which steam-driven machinery is employed.

The drilling of petroleum wells has been brought to such perfection that depths of a mile or more may be reached without serious difficulty in a moderate length of time, but the yield of oil needs to be considerable to render drilling to such depths a profitable undertaking. Four years ago there were in the Boryslaw-Tustanowice oilfield of Galicia sixteen wells of a depth of more than 5000 ft., and one was then yielding oil from strata which had been reached at 5873 ft., or nearly a mile and a furlong.

It not infrequently happens that oil is met with on completion of the well under such high pressure, sometimes several hundred pounds on the square inch, that the flow is uncontrollable. Most of us have seen pictorial representations of the famous oil-fountains of Baku, but less is known of similar occurrences elsewhere, which were of an even more remarkable character. A fountain in the Grozni oil-field in the northern Caucasus, which began to flow in August, 1895, was estimated to have thrown up during the first three days more than 4,500,000 gallons, or about 18,500 tons, of oil a day. It flowed continuously, but in gradually diminishing quantity, for fifteen months, quickly destroying the derrick, and afterwards periodically. When I visited the spot in April, 1897, there was still an occasional outburst of oil and gas. To save the enormous volume of oil ejected an army of workmen was employed day and night in throwing a dam across the valley, so as to form a gigantic reservoir. This dam gave way, and a second was constructed below it; a third, still lower down the valley, being afterwards added as a measure of precaution.

Probably the most sudden and violent of the outbursts of oil which have been experienced is that which occurred in 1908 on the San Diego property of Messrs. S. Pearson and Son (Lord Cowdray's firm) in Mexico. In the early morning of July 5 in that year oil was struck in a well known as No. 3 at a depth of 1824 ft. The pressure gradually increased, and in fifteen or twenty minutes the ground round the well began to tremble. In various places, some so far distant as 250 ft. from the well, fissures appeared, through which oil and gas were emitted. One of these fissures extended under the boilers, and although the fires had been drawn the gas ignited. The flame was immediately communicated to the outflowing oil, and the well burned for a period of fifty-eight days with an estimated loss of 3,000,000 barrels of oil.

The flames reached a height estimated at 1460 ft., with a maximum breadth of about 480 ft. So brilliant was the light emitted that at 9.40 p.m. on July 8 persons on board a vessel at anchor in the Tamiahua lagoon, a distance of nearly eleven miles from the well, were able to read a newspaper by it. This is the more remarkable when it is considered that the approximate limit of distance at which an object 100 ft. high is visible to a spectator at sea-level is a little more than twelve miles, so that unless the light from the burning well had been reflected from smoke or cloud, only the upper part of the column of flame could have had illuminating effect at the distance recorded. Besides ejecting the large quantity of oil mentioned, the well yielded a considerable volume of water, estimated to reach at times nearly 1,500,000 barrels daily. This great flow of liquid carried away from the sides of the well solid matter estimated approximately at 2,000,000 tons. On August 31 the flow of oil temporarily subsided, and it became possible to extinguish the fire by means of sand pumped into the crater with centrifugal pumps. On September 26 the area of the crater was about 15,000 square metres, and on January 28 of the following year about 117,600 square metres.

The deposit of ozokerite in Boryslaw, Galicia, is unique, although the mineral occurs in other localities in that country, as well as in Russia and in Utah. The Boryslaw deposit underlies a pear-shaped area, the central and richest part of which is about fifty acres in extent, but this is surrounded by an outer zone of less productive territory, which increases the area of the workable field to about 150 acres. The ozokerite occurs in veins varying from extreme tenuity to many feet in thickness. It is usually plastic, and has evidently been forced up from underlying beds by lateral pressure through fissures resulting from the local yielding of the marl to the compressive strain. The pressure which still exists is attested by the viscous flow of the ozokerite in the mines and by the frequent distortion or collapse of the timbering of the galleries. As an illustration of this it is recorded that in one mine the perforation by a miner's pick of a thin, impervious stratum of rock forming the floor of a gallery resulted in the gradual appearance of a vertical stalk of ozokerite, which for a long time was replaced when it was removed. This curious appearance of growth gave the name of Asparagus Mine to the working.

Crude petroleum varies greatly in character, some descriptions being of pale colour and highly mobile, whilst others are almost black and viscid. The specific gravity appears to range from 0·771 to 1·06.

As regards its chemical composition, petroleum consists essentially of carbon and hydrogen, together with oxygen, and varying amounts of nitrogen and sulphur.

Pennsylvanian petroleum consists chiefly of a large number of hydrocarbons of the paraffin series, whilst naphthenes or polymethylenes are the predominant constituents of Russian petroleum. In some descriptions of crude petroleum, notably those of the Dutch East Indies, Persia, and Burma, aromatic hydrocarbons are largely present.

These paraffins and naphthenes are very accommodating, in the sense that they readily lend themselves to conversion, by dissociation, or "cracking," as it is termed, into other compounds of carbon and hydrogen, of lower boiling-point or higher volatility, which are so largely in demand at the present time in the form of motor-spirit. The conversion occurs when the oil is distilled under pressure or is brought into contact with highly heated surfaces. The chemical changes which occur in these circumstances and the constitution of the products were investigated by Thorpe and Young many years ago. In 1888 I was privileged to be associated with the Fullerian professor in experimental work which involved the construction of suitable apparatus for carrying out the process on a practical scale, and it was found that in order to obtain the best results it was necessary to effect the condensation of the vapour also under pressure. The process devised at that time is essentially the same as that which is now very largely carried out in the United States, with the object of augmenting the inadequate supplies of motor-spirit normally obtainable from the crude oil by fractional distillation. By carrying this treatment further it is possible to obtain aromatic hydrocarbons.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Stonyhurst College, Blackburn, is aiming at raising 20,000*l.* as a war memorial, and the bulk of this sum will be devoted to the erection of new science laboratories.

Mr. S. H. Stroud, formerly demonstrator in chemistry in the School of Pharmacy, Bloomsbury Square, has been appointed lecturer in pharmacy and chemistry in the University of Sydney, N.S.W.

Dr. Richard C. Maclaurin, president of Massachusetts Institute of Technology, has, we learn from *Science*, accepted the appointment of director of college training, in charge of the Students' Army Training Corps under the U.S. War Department's Committee on Education and Special Training, which aims at mobilising the higher institutions of learning.

It is stated in *Science* that the residuary estate of the late Mr. John W. Sterling, which it is estimated will amount to 3,000,000*l.*, has been left by the terms of his will to Yale University. The clause which gives the residue of the estate to Yale University contains the following passage:—"All the rest, residue and remainder of my estate not hereinbefore effectually disposed of, I direct my said trustees to dispose of in the manner following: To apply the same, as soon after my decease as may be practicable, to the use and for the benefit of Yale University, in the erection in New Haven, Conn., upon land selected at its expense by it with the approval of my said trustees, of at least one enduring, useful, and architecturally beautiful edifice, which will constitute a fitting memorial of my gratitude to and affection for my *alma mater.*"

A group of large firms engaged in the principal industries of the Manchester district has offered to the governing body of the College of Technology, Manchester, the sum of 3000*l.*, spread over a period of five years, towards the cost of establishing a new department of industrial management, and this has been accepted by the Manchester City Council. A lecturer will shortly be appointed for this period of five years, at a salary of 600*l.*, to conduct research in the subject of industrial management, to organise a new department, to lecture to members of the college and to the public, and to assist industrial concerns in the solution of management problems. To make doubly sure that the department shall keep in close touch with practice, a number of managers, directors, scientific experts, and others who have had special experience or are responsible for important innovations will be invited to deliver public lectures, being offered substantial fees for placing their knowledge at the disposal of their fellow-managers, and thus serving to encourage enterprise and experiment in matters connected with management.

A significant indication of the Government's attitude towards higher education and of its readiness to increase the State aid to universities was given by the Prime Minister in his reply to a deputation, which he recently received, representative of university education in Wales. That the Government is prepared to approach the question of grants to education in a spirit totally different from that which formerly prevailed was made abundantly clear by Mr. Lloyd George. In Wales it is proposed that the county councils should levy a penny rate for higher education, and some of the councils have already decided to do so; and the Government is now asked to give a pound for each pound raised locally. Before an increased grant will be made, however, the University authorities must draw up a scheme for the expenditure of the money, and this must receive the approval of the Government, advised by the President of the Board of Education. It is also laid down as an essential condition of increased aid that the county councils shall agree to a pooling of their resources, and that the county contributions shall be made unconditionally and without the claim that so much of the money shall be used for founding scholarships. It is explained that any increased grant made as a result of increased local effort will be supplementary to the grants made for the training of teachers and for agricultural education, and every indication of a desire to give much greater assistance to universities was shown by the remarks of the Prime Minister. The question of making proportionate grants by the State towards capital expenditure is under consideration. The treatment given to Wales will be given to other universities also, and the Prime Minister stated that every claim for increased State aid on behalf of other universities would be considered by the President of the Board of Education "in a thoroughly liberal and enlightened spirit." Special reference, it should be added, was made to the low scale of salaries and pensions for professors—"There is no greater folly than to underpay these men, apart from the cruelty of it. It is stupid beyond words; it is unutterably stupid"—and the University of Wales is admonished, in any scheme which it may submit, to do something to improve the pay and sense of security of the teacher. As the amount of State aid will depend on the amount of local contributions, it is to be hoped that the country as a whole will rise to a sense of its responsibilities and its privileges.

SOCIETIES AND ACADEMIES.

London.

Faraday Society, July 23.—Sir Robert Hadfield, president, in the chair.—J. G. A. **Rhodin**: Contributions to the chemistry of aluminium and aluminium alloys. The paper dealt with the sorting of various kinds of scrap according to the percentage of aluminium by means of direct determination of aluminium, soluble in 10 per cent. NaOH. The method was described in detail, and it was claimed for it that it allowed oxide to be determined as well. Certain phenomena relating to the behaviour of aluminium powder, when heated in air, were discussed, and also the preparation of Al_3O_4. A curve of specific gravities corresponding with percentages of aluminium in various alloys was given. Determination of specific heats was mentioned as an alternative.—R. J. **Anderson**: Metallography of aluminium: recrystallisation and grain-growth—the result of deformation in the cold prior to annealing. During the course of some recent tests on the recrystallisation of cold-rolled aluminium sheet on annealing, some interesting recrystallisation and grain-growth phenomena were observed in this metal, which are confirmatory of the general laws of grain-growth and recrystallisation as now understood. While the degree of strain is indefinite, the effects of temperature on deformed aluminium are recorded, and instances of differential grain-growth are presented. These results appear to show definitely that aluminium is similar to other metals as regards annealing laws.—Prof. H. J. M. **Creighton**: Reinforced concrete *v.* salt, brine, and sea-water. On account of the rapidity and cheapness of construction, at present attention is focussed on the reinforced-concrete ship. The durability of this is still an undetermined factor, but in a large measure it will depend upon the action of the sea-water on the concrete and on the iron reinforcements. Reinforced concrete immersed in brine or sea-water is liable to subtle and persistent deterioration, due to electrolytic action between the salt and the reinforcements. Therefore, the permanence and durability of reinforced-concrete ships are matters of considerable doubt, unless the sea-water is prevented from coming in contact with the reinforcements. Such prevention may be effected by coating the reinforcements with protective paint, or by applying to the outer surface of the concrete some material which will render it waterproof.

PARIS.

Academy of Sciences, August 5.—M. P. Painlevé in the chair.—J. **Boussinesq**: The second and third formulæ of Tresca, for punching a block, with a lateral surface, not free, but cased in a rigid, polished, hollow cylinder, and for its flow through a lower orifice under the pressure of a piston of the same radius as itself.—A. **Blondel**: A phenomenon of instrumental diplopy and its application in medicine. The prism binocular may be used in the diagnosis of affections of the central nervous system, as, under certain conditions, a patient sees double images through the binocular, although seeing a normal single image by direct vision.—G. A. **Boulenger**: What is the *Eleotris gobioides* of M. Legendre?—G. **Sizes**: The doctrine of Aristoxene; temperament of the Pythagorean scale.—P. **Weiss**: The characteristic equation of fluids. A study of the isochores of air, plotted from Witkowski's experiments, of ethylene and ether, from Amagat's experiments, and of *iso*pentane from S. Young's data, shows that isochores in each case consist of two straight lines inclined at an angle. The theoretical interpretation of this bend in the isochore is not obvious, but a similar bend is shown by the corresponding magnetic phenomenon.—L. **Tschugaeff**: A new reaction of osmium. A solution of OsO_4 or K_2OsCl_6, heated with thiourea in excess and a few drops of hydrochloric acid, gives a deep red or rose coloration, according to the concentration of the osmium solution. The reaction is characteristic and will detect osmium at a dilution of 1 : 100,000.—Ch. **Gorceix**: The post-Würmian Fier.—L. **Gentil**: The geology of Andalusia.—J. **Amar**: The nutritive equilibrium of the animal organism. Remarks on a recent paper by F. Maignon (July 22).—A. **Besredka**: Vaccination against dysentery by the mouth.—H. **Vincent** and G. **Stodel**: Antigangrene serotherapy by a multivalent serum.—A. **Sartory**, G. **Blaque**, and M. **Schulmann**: A case of pulmonary sporotrichosis. A tumour in the lung, giving all the apparent signs of tuberculosis, but no Koch bacillus in the sputum, proved to be due to *Sporotrichum beurmanni*.

CAPE TOWN.

Royal Society of South Africa, June 19.—Dr. J. D. F. Gilchrist, president, in the chair.—J. R. **Sutton**: A note on the possibility of long-range weather forecasts. The author shows that the June temperatures, and especially the minima, at Kimberley are modified by the character of the May rainfall.—J. S. v. d. **Lingen** and A. R. E. **Walker**: Preliminary note on Anatase. The authors gave a preliminary account of their investigations on the radiation pattern of Anatase.

BOOKS RECEIVED.

The Processes of History. By Prof. F. J. Teggart. Pp. ix+162. (New Haven, Conn.: Yale University Press.)

The Portal of Evolution. By a Fellow of the Geological and Zoological Societies. Pp. 295+ii. (London: Heath, Cranton, Ltd.) 16*s.* net.

Handbook of Travel. Prepared by the Harvard Travellers' Club. Pp. 544. (Cambridge, Mass.: Harvard University Press.) 2.50 dollars.

Descriptive Catalogue of the British Scientific Products Exhibition, August 12–September 7, 1918, with Articles on Recent Developments. Pp. xxiii+236. (London: British Science Guild.) 2*s.* 6*d.* net.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.